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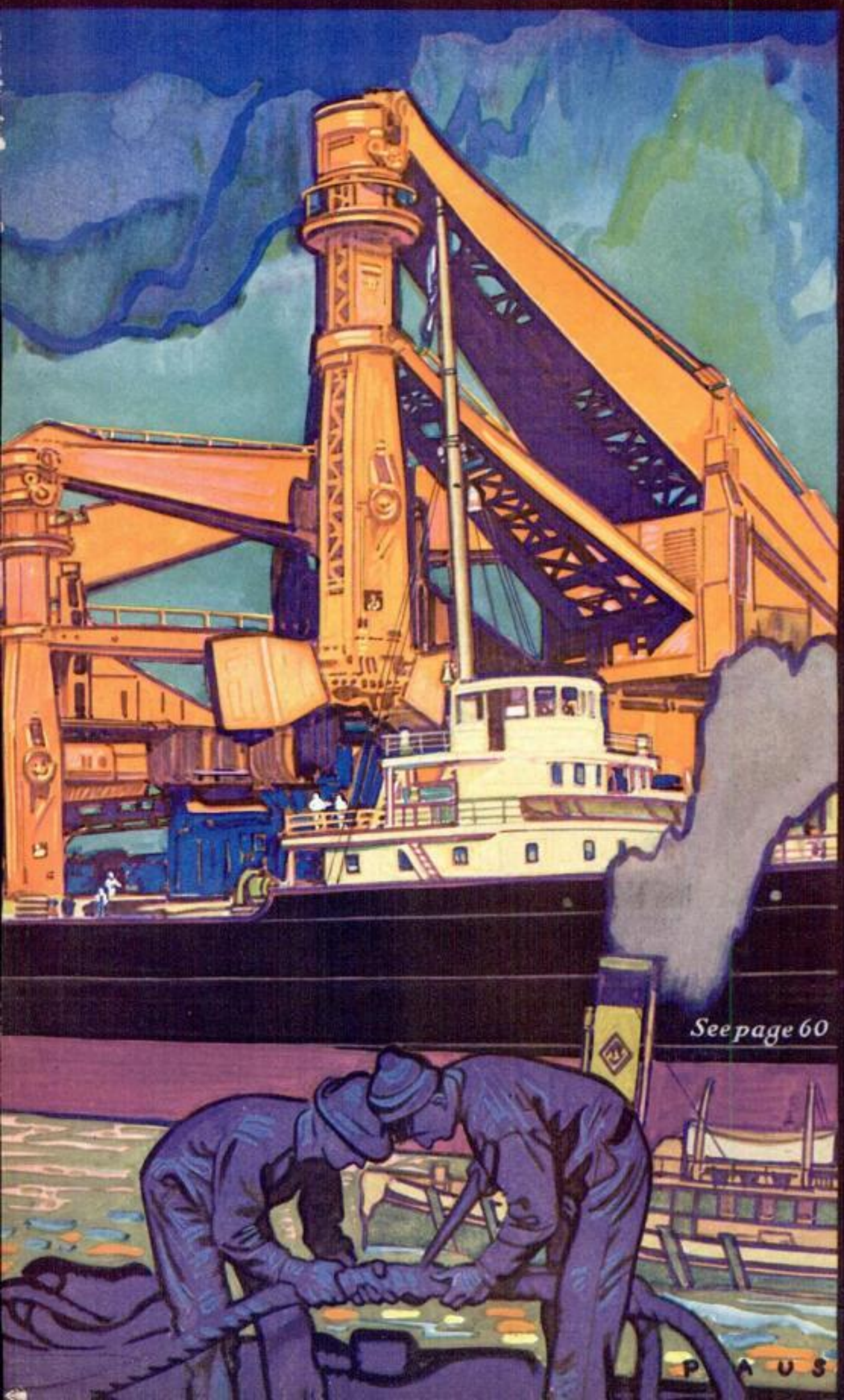

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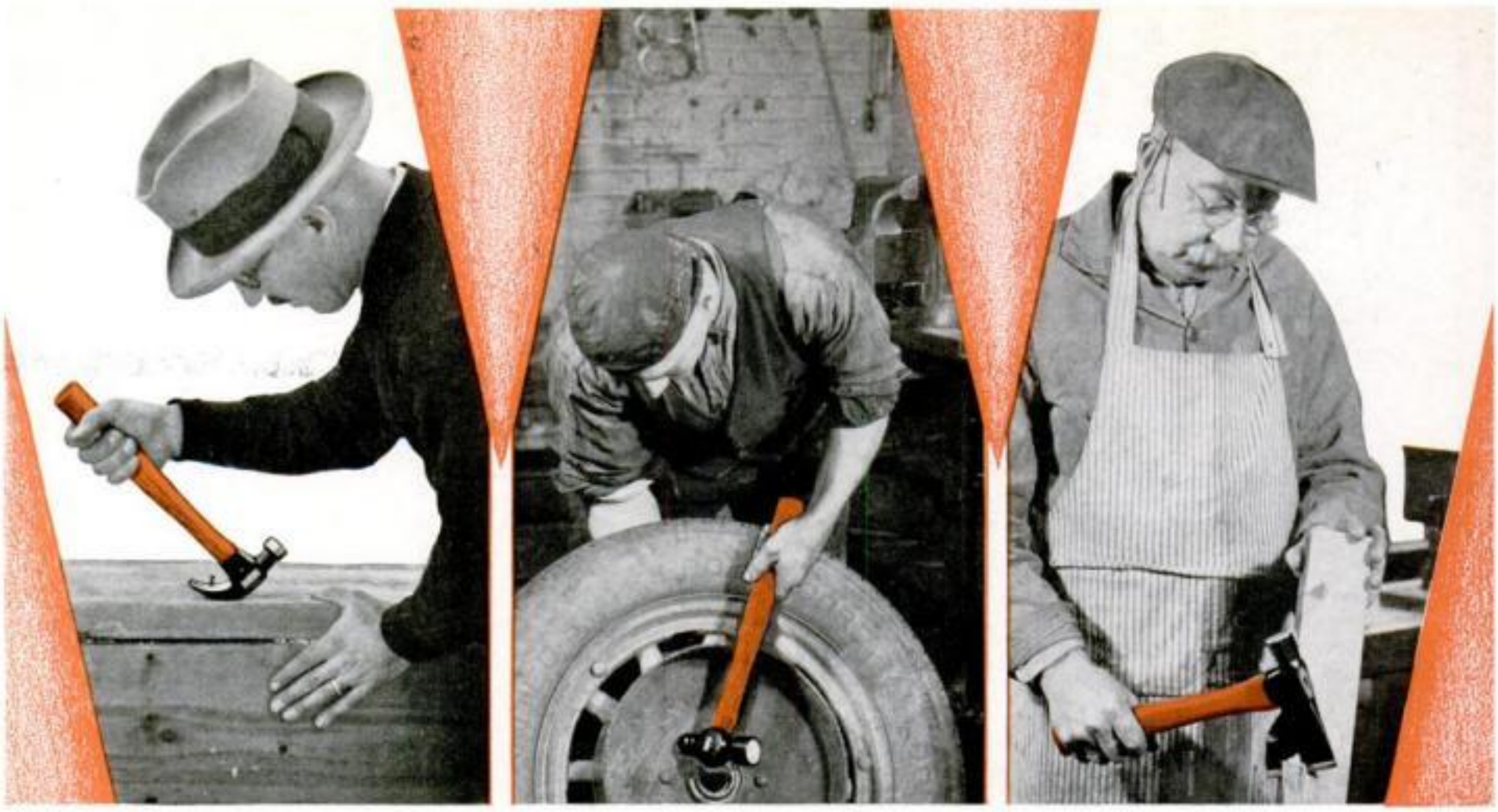

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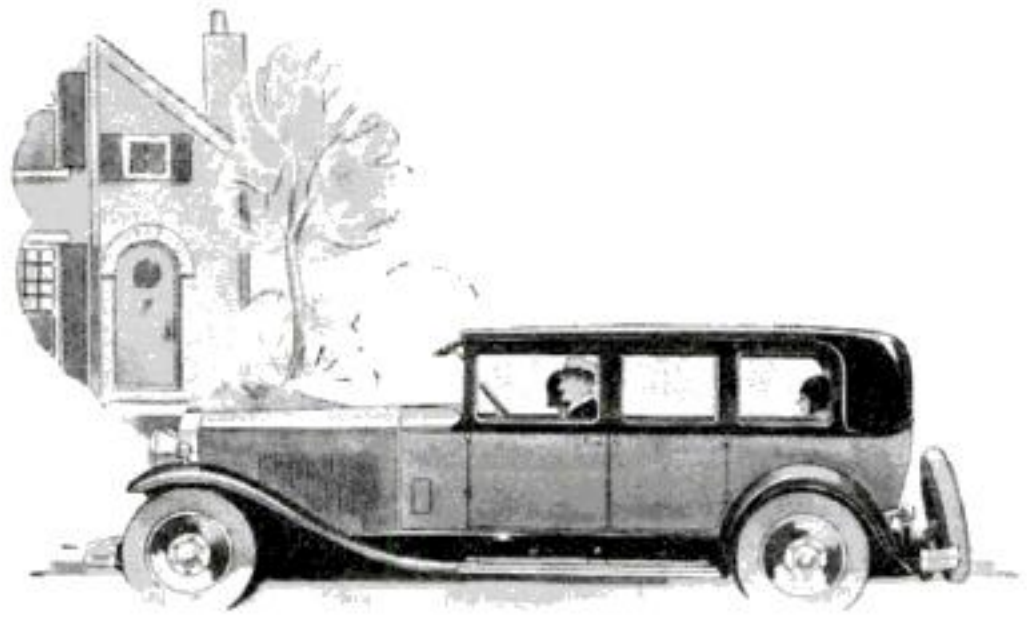

TO BE SURE, men who are thoroughly familiar with motor car construction can tell you whether a car is in good running condition or whether it is pretty well worn out; whether a car is worth the money asked for it or not. But to whom should you go for this information and where are you most likely to find a used car that will prove satisfactory and a sound investment?

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May, 1930, Vol. 116, No. 5. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3.

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Buying Securities at 85c on the Dollar

By CHALLIS GORE, *Financial Editor*

THERE were two letters from the Bank for the twin brothers. Each contained a check for $12,500, the capital sum of their father's estate, now being given to them on their 30th birthdays.

The investment question was foremost in the mind of each, and the variations in their essentially conservative natures so directed their decisions that an interesting comparison in results came to light the next day at dinner.

"Look at the list of stocks I bought," said Gregory; "everyone a leader in its field, diversified essential industries. Ten shares of each, to guarantee me a good income and no grey hairs before my time."

Abbott, the younger looking of the two, glanced at the list, reading it half aloud: "American Can, American Telephone & Telegraph, Anaconda Copper, Atchison, Consolidated Gas of New York, General Electric, National Biscuit, Standard Oil of New Jersey, Union Carbide and Carbon, United States Steel."

"Speak for themselves, don't they?" Gregory couldn't conceal the pride in his voice.

Abbott's slow voice doubled the effect of his reply. "Can't criticize that selection. Own the same stocks myself—along with about 175 others."

"175!"

"Yes," continued Abbott, "I bought some shares in a general management investment trust and they happen to be holding every one of your stocks. By the way, I'd like to bet I have the better bargain of the two. What are you holding American Can at?"

"141⅛" Gregory countered.

Abbott smiled. "Mine cost me at the rate of $122.07 a share—and I bought it the same day you did."

"Impossible. The low for the day was 140¼."

"Just a minute," Abbott continued, "and I'll explain everything. Each one of these investment trust shares cost me $55.00. But the assets in cash and securities in back of each share amount to $63.60. Figure it for yourself. On that basis I paid approximately 86½c for each $1.00 value, and 86½% of 141⅛, your price on American Can, is $122.07."

Then Abbott took a pencil and copying off Gregory's list, tabulated the comparisons as follows:—

	Gregory's Cost	Abbott's Cost	Abbott's Saving
American Can	141⅛	$122.07	$19.05
American Tel. & Tel.	237½	205.43	32.07
Anaconda Copper	73¼	63.36	9.89
Atchison	228½	197.65	30.85
Consolidated Gas	119¼	103.15	16.10
General Electric	74	64.01	9.99
National Biscuit	83⅞	72.55	11.32
Standard Oil of N. J.	59⅜	51.35	8.02
Union Carbide	91	78.71	12.29
United States Steel	182½	157.86	24.64
Totals	1,200⅜	$1,116.14	$174.22

"Of course," Abbott pointed out, "that's figured out on a basis of one share in each company. On your ten share basis I paid $1,742.20 less than you for my securities.

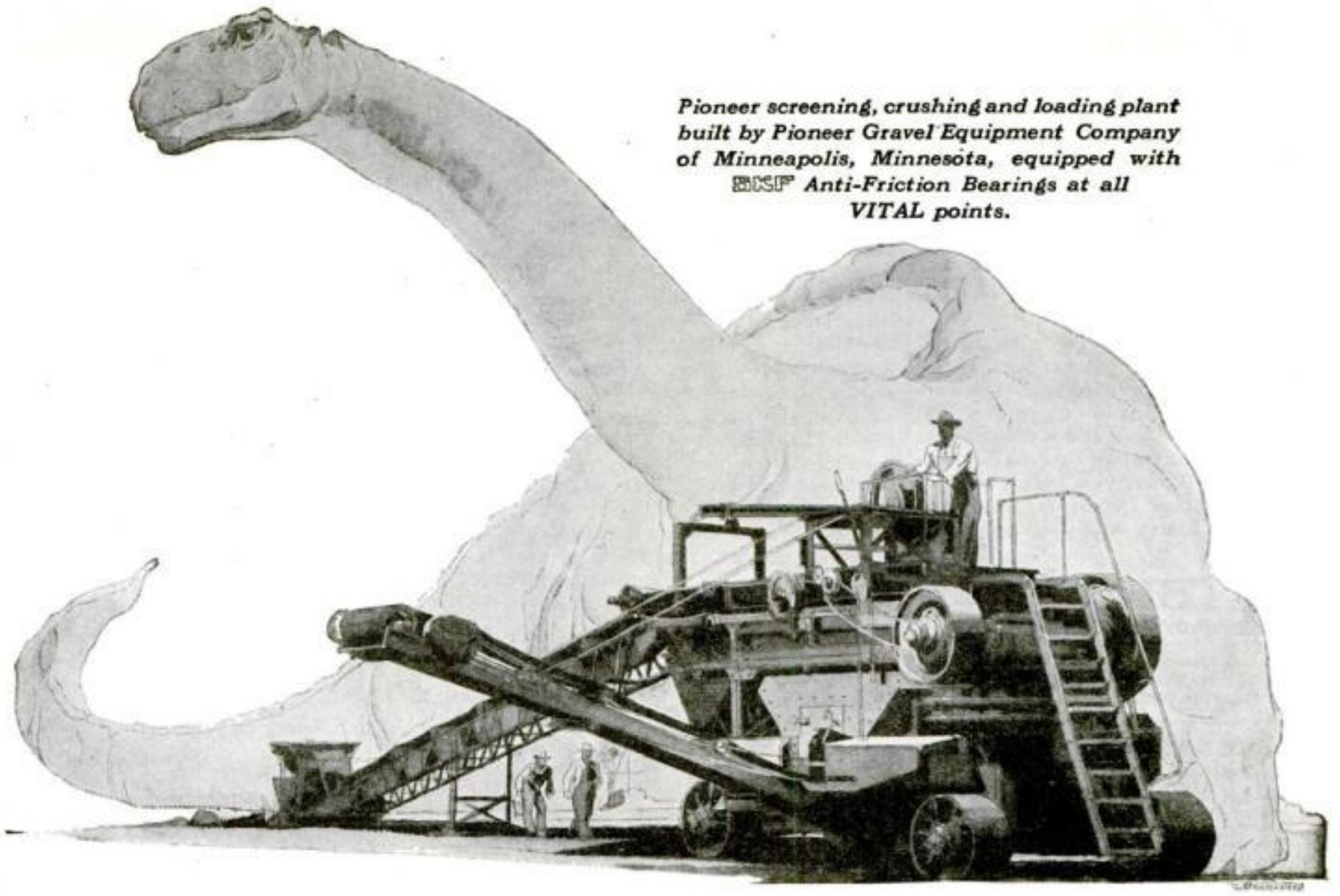
"But don't jump to conclusions about our relative positions before you consider certain facts. I don't actually own ten shares in each of the ten companies, as you do. When the trust was organized it issued 275,000 shares of its own stock, for a total sale of about $18,000,000. Some of this money is in the bank, some of it loaned on call, and the bulk of it is invested in securities, including domestic and foreign bonds, preferred and common stocks. So my 225 shares represent 225/275,000ths of all the trust's assets. For example, they own 3,000 shares of American Can, and my proportion is a bit under 2½ shares. Similarly, I own a small fraction of their holdings in each of 175 different securities.

"Now, if you compute the present market value of these securities, add the cash the trust has, subtract its liabilities and divide the remainder by the number of shares issued, you naturally get the asset value of each share. As I said before it comes to about $63.60 a share, for each of which I paid $55.00. Then on each share I get $8.60 more in the cash and security value than I paid for. So that my 225 shares total an excess value of $1,935. Or to put it another way, if the investment trust sells all its securities at today's closing prices, I would receive $14,310—and for that I paid $12,375.

"And here's another angle to consider, Gregory. In a measure I'm protected against fluctuations in the day to day or month to month market value of my holdings. Because my investment entitles me to a pro-rata interest in the actual cash dollars which the trust has deposited in the bank. The balance sheet gives the figure as a bit over $1,800,000. According to the figures I've shown you tonight, my share in these dollars cost me a fraction under 86½c each. There alone I'm in something like $200.00 over and above what I paid.

Gregory was puzzled; the figures were plain enough, but there seemed to be a faulty premise somewhere. He went over his brother's argument and suddenly remembered a question Abbott's explanation had prompted in his mind. "I can't see the reason for the difference in price between stocks bought direct and the price of shares of an investment trust owning the same stocks."

"Neither did I," Abbott came back, "till Carson down at the bank explained it this way. Popular interest in investment trusts hit a peak last year, and in response, a tremendous flood of issues reached the market, (*Continued on page 6*)



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Buying Securities at 85c on the Dollar

(Continued from page 4)

particularly just before the crash. In typical American fashion the public bought more of these stocks than they could pay for out of accumulated savings. A great deal of them were purchased on borrowed money, placing the investment trust shares in what Carson described as a poor technical position. In other words a large volume of these shares were being carried by people financially unable to hold them through such a violent decline as took place last October and November.

"Suppose you held ten stocks last October, and borrowed $7,000 against them. The crash comes, bank demanding payment of the loan; you can't meet it. You're forced to sell your securities. Listen, Gregory, millions of people were caught that way. During the panic the number of people in that position greatly outbalanced those who were able and willing to buy. Prices broke sharply. The best investment trust issues suffered along with the worst.

Then again, many investment trust issues were only partly distributed among investors, when the break occurred. You see, while the original sale is being transacted the underwriters maintain a repurchase market to bid for and buy back stock which any investor wants to sell. When the sales tide was at its height, bankers found it necessary to suspend repurchasing all the stock offered. The removal of this support further aggravated the extent of the decline.

"On top of that came the needless, hysterical selling of securities held outright by panicky investors who saw prices decline, and dumped their stocks on the market without a bit of reason. Before the deluge subsided, the best investment trust stocks were selling below their intrinsic value.

Abbott paused to light a cigarette, and catching his brother's eye for a moment, could see that Gregory was starting to get the drift of his argument. He continued, "Naturally, the worth of such stock can't be safely judged entirely by the liquidating value of its assets over and above its selling price. There are other important considerations, among which management is one of the principle factors. Last year offered a severe test of this. Good management was proved, poor methods exposed.

"Even now the securities held by my trust re selling at less than 2% below their original cost to me. Take the Exchange list as a whole and you'll find that the average depreciation in price is a good deal more than that. Strongly indicating that good management held the decrease to so small a figure in face of the violent upheaval that took place on the market last year. And at that, some trusts survived without any loss, though they were mostly outfits that organized and made their investments several years ago, at prices lower than those reached in the crash.

"Listen to this clipping from the New York Evening Post that Carson handed me at the bank:

" 'The fact that shares of even some of the strongest and most highly regarded trusts are selling below their liquidating values seems almost unbelievable—How long quotations for stocks of leading trusts will continue to lag behind liquidating values is uncertain. Wall Street is confident this situation must soon disappear—these stocks under normal conditions should sell above liquidating values. for management should command a premium.' "

Walking home that night, Gregory carefully reviewed all that his brother had said, and came to the conclusion that while he had certainly chosen his investment stocks wisely and conservatively, Abbott. taking no greater risks than himself, had gained the better bargain.

* * *

Note: This article was written March 3rd, at which time some real investment trust bargains continued to exist. It is, of course, impossible to forecast prevailing prices when this reaches the reader. Yet the fact remains that as an aftermath of the panic, cash and securities were obtainable, and may still be, at prices representing discounts which may not be duplicated in years to come.

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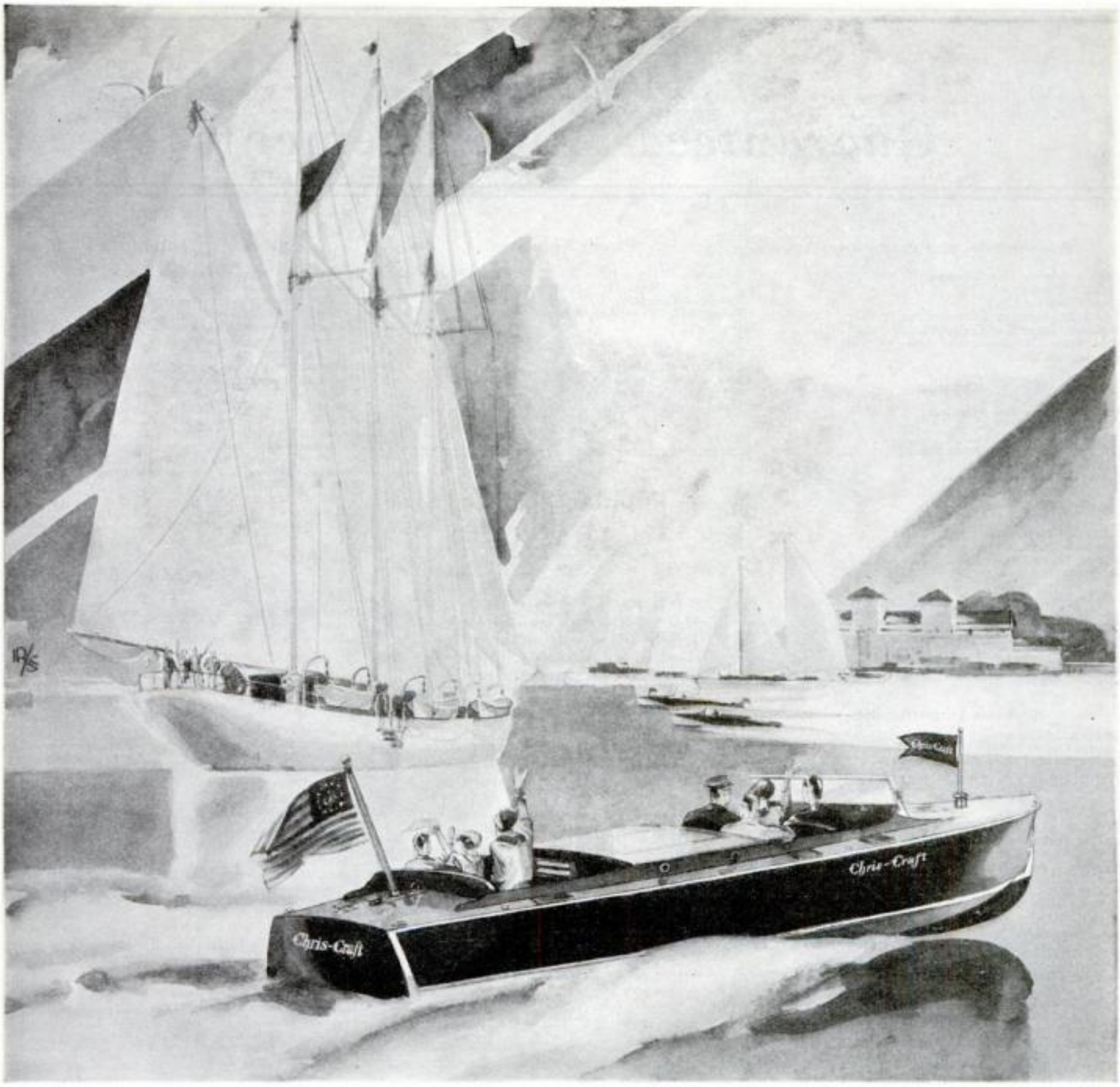

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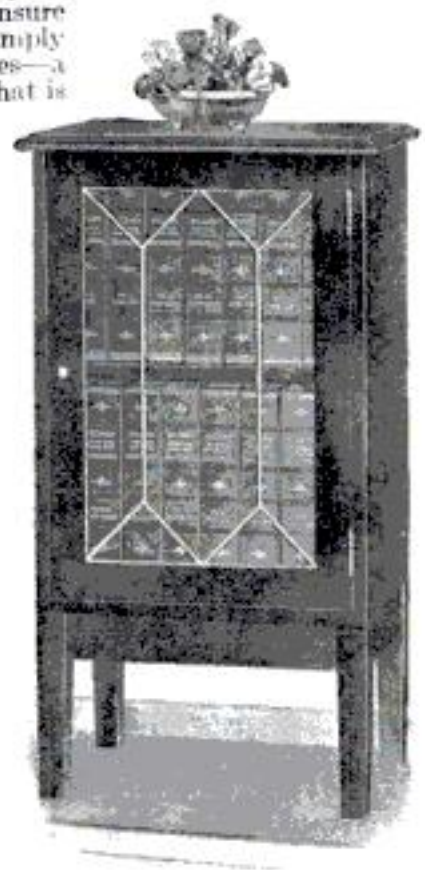

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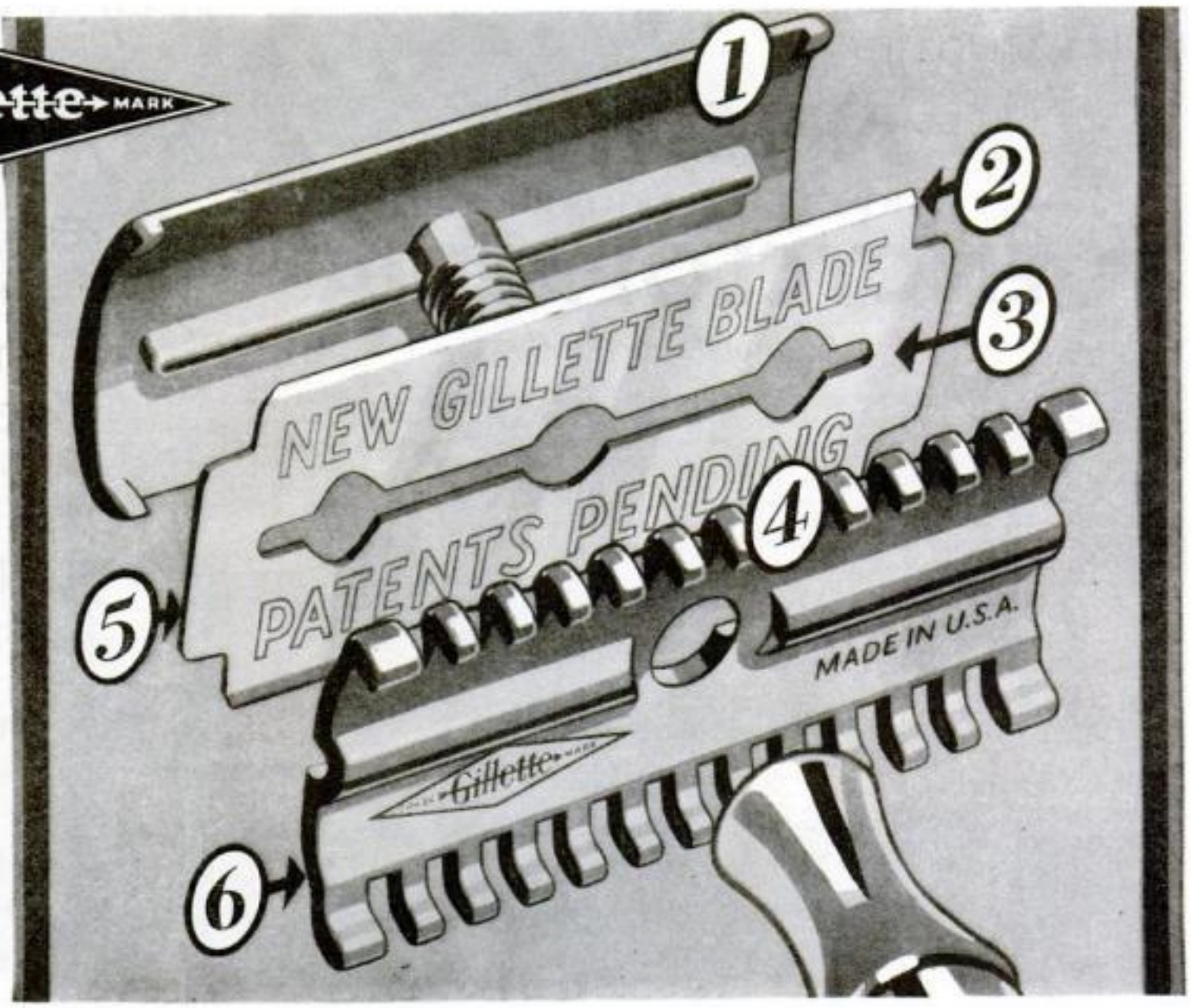

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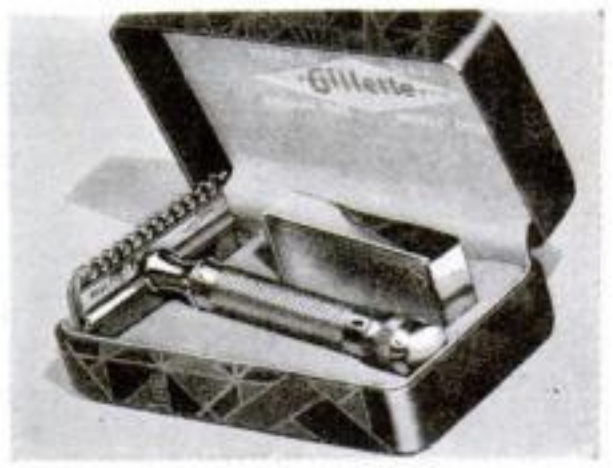

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Is It a Refrigerator or Just a Box?

By F. G. PRYOR

Secretary, Popular Science Institute

ONLY five years ago, refrigerator buyers were asking for good-looking cabinets, big enough to hold the family's supply of perishable foods, not too expensive, and not too hard on the ice. That was what they asked for, and that was just about what they got.

Today, there are quantities of *real* refrigerators being made and sold, and we refer not only to the satisfactory mechanical refrigerators on the market but also to the excellent refrigerators of the ice type now available. This has all come about as the result of public demand. A few years ago, when the buying public was aware neither of the advantages of proper food preservation nor of what good refrigeration consisted, manufacturers were obliged to comply with the demand for cheap, attractive looking but poorly built boxes. The majority of refrigerators made then came under this classification. For the discriminating few who required real refrigeration, a much smaller line of refrigerators was made. They were necessarily high priced because they were manufactured in limited quantities.

The market presents a different picture now. An increasingly large proportion of consumers are coming into stores today and asking for refrigerators insulated and constructed so as to be real refrigerators—that is, maintain a temperature not over forty-five degrees Fahrenheit in the milk compartment and an average temperature not over fifty degrees Fahrenheit in the large food compartment when the outside temperature is at seventy-five degrees Fahrenheit. Prospective buyers now ask to see a section of the refrigerator wall and they discount any sales talk of "air-space insulation," demanding a substantial thickness of some good insulator.

GOOD refrigerators are available today at lower prices than ever before because of better design and quantity production. Improvements have been made in interior design which add much to the efficiency of the refrigerator and comparatively little to its cost. Good refrigerators now have a long baffle, which makes for better air circulation, and properly dimensioned ice compartments.

The trade is merely following public demand in this respect. One of the greatest chains of department stores in the country recently threw out all refrigerators in stock that were not insulated and replaced them by those that met the requirements of the up-to-date purchaser.

In line with the general progress in refrigeration is the effective work undertaken by the American Standards Association. This body joined with about fifty organizations in working out refrigerator standards and the work, which has been under way for two years, is nearing completion. The organizations represented on the Committee include the Bureau of Home Economics of the United States Department of Agriculture, the American Home Economics Association, the purchasing departments of the United States Army and Navy, the National Association of Ice Industries, the American Institute of Refrigeration, and a number of others, including Popular Science Institute.

Under the leadership of the American Standards Association these organizations are setting definite standards for various grades of refrigerators so that a buyer may know whether he is getting an A, B, or C grade refrigerator, or whether the box he is considering is not even entitled to be called a refrigerator.

FOR example, through the activities of this standardization group, a refrigerator buyer will soon be able to go into any progressive store handling refrigerators and ask for a box having, say, five cubic feet of food space, and he will be given a choice of an A, B, or C grade refrigerator. Any one of the three will be sufficiently well built to prove durable and maintain proper temperatures. However, if the buyer can afford the higher initial price of the A-grade box, he will be able to do with twenty-five pounds less ice than if he took the B-grade, and fifty pounds less than with the C-grade.

The A-grade box will be of finest construction and insulated with two inches of corkboard or its equivalent in any other satisfactory material, while the B-grade box will have but an inch and one half of corkboard and the C-grade only one inch. To offset the increased heat leakage into the more thinly insulated boxes, they require proportionately larger ice chambers for proper temperatures to be maintained.

While the advance in home refrigeration during the past few years has been great, and much good will result from the work now being done by the organizations mentioned above, there still will be considerable room for improvement in refrigerating conditions while so many families remain unaware of the importance to good health of proper food preservation. Dr. M. E. Pennington, Director of The Household Refrigeration Bureau of the National Association of Ice Industries, estimates that only fifty per cent of the homes in this country have *any* means of refrigeration and only one tenth of this group have *real* refrigeration.

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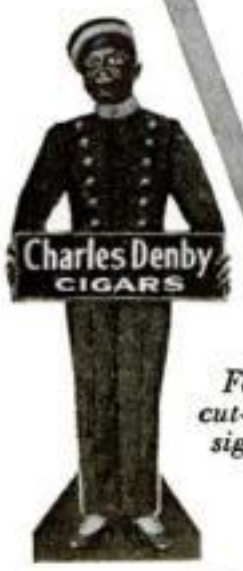
Thousands of dollars saved in the elimination of a single process... freedom from rusting and denting, ease of working, and beauty and permanence of painting. These advantages have made Masonite Presdwood the ideal sign material. And in industry after industry the same exceptional qualities of this grainless wood board have dictated its use for everything from toys to motor truck bodies.



For cut-out signs

For motor truck body paneling

Roadside signs of Presdwood are outlasting those of other materials. This grainless wood is highly resistive to moisture and warping. It requires no preliminary acid wash, has a broad, smooth surface which takes paint perfectly. Scorching heat and bitter cold have practically no effect on finish applied to Presdwood, for the minutely fibrous surface bonds firmly with the paint and there is almost no expansion or contraction to make the paint peel or crack.

On the farm

In reducing factory costs and improving products, these same qualities of Presdwood make it almost invaluable. It does not crack or splinter, can be nailed near the edge without splitting, and is readily worked on punch press or band saw.

Helps keep eggs—or hatch 'em

For chick signs

Presdwood makes iceboxes and incubators, bee hives and bird houses, shipping containers and breakfast nooks, table tops and bookcases, kitchen cabinets and speed boat decks. It lines concrete forms for stately buildings, provides permanently beautiful paneling for the finest homes.

Manufacturers, sign makers, builders and home mechanics should read the Presdwood booklet and examine a sample of Presdwood. Both the booklet and sample are sent to you, Free, without obligation. Just clip out the coupon and mail it in NOW.

For painted bulletins

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111 West Washington Street
Chicago, Illinois

Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION

MASONITE CORPORATION
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Please send me, Free, a sample of Masonite Presdwood and the Presdwood booklet.

Name .....

Address .....

City ..... *State* .....

Our Readers Say

Here Are Two for the Book

IF THAT "What's Wanted" book of inventions that you used to keep is still in existence, here is an invention that seems to me perfectly possible in this mechanical age—much needed and yet, as far as I know, not available. That is a simple *home* outfit for recording your own phonograph records.

We have home movies and home radios. Why not a home phonograph recorder? What budding musician, for instance, wouldn't like to make a record of his own playing on the piano or piccolo or even—friends willing—on the saxophone? And baby's first words could be preserved to be played years later. An evening's dinner table conversation might be worth playing over in later life. The wonder, it seems to me, is that no satisfactory home recording outfit is available. P. S.—A friend of mine asks me to include another suggestion—a timing switch for the electric light, to be used in printing photographs, that will automatically shut the light off after an interval of, say, one fourth of a second to two seconds. —G. F. B., Passaic, N. J.

Where Are the Whiskers of Yesteryear?

IN LOOKING over the pictures of the eminent modern scientists who will award POPULAR SCIENCE MONTHLY'S $10,000 prize, I notice that not one has a beard. Then I turned over the page and saw the photograph of the inventor of the pneumatic tire hiding behind a bushelful of whiskers. I'll bet he had to stop every block or so to untangle that beard from the sprocket of his bicycle. Or maybe he tucked it in his vest. When I think of all the trouble long whiskers must have been, I nominate, as the greatest modern invention, the safety razor!—J. A. U., Chicago, Illinois.

But Where Would You Park?

I WAS at a motor boat show one night recently and when I came out I happened to look up at the sky and see the planet Mars. It was nice and red as usual and although I couldn't see the canals, of course, they gave me an idea. Why not have canal systems for our modern cities, with neat little motor boats plying swiftly or gently as the spirit moves them through the silvery thoroughfares? All the noise, dust, and general hubbub of automobile traffic could be at least alleviated, and the majority of citizens might be glad to use this means of getting about when they weren't in any special hurry or had no enormous load to carry. Anyway, so far as speed is concerned, these new water runabouts seem to be able to hold their own. And would water highway construction necessarily be more expensive than that of asphalt or cement? Even if it were, wouldn't the romantic background thus provided be worth the cost? Besides, think of the contribution to civic beauty if several of our cities should be turned into modern Venices on a large scale.—E. C. G., New York City.

Your Fish Isn't a Fish

I NOTICED H. W. M.'s letter in the February issue of your magazine describing the fish he has. I am under the impression that it is not a fish but an aquatic batrachian. The batrachians are related to the amphibians, but differ in the respect that the amphibians will probably die on land and drown if they remain too long in water.

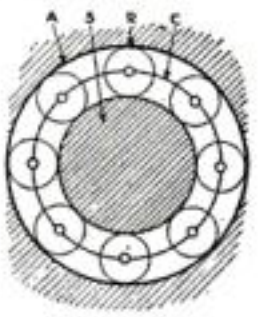
The batrachians stand midway between the reptiles and fish, and are divided into three classes:

1. The Anura or tailless.
2. The Apoda or limbless.
3. The Urodela, taking in newts, salamanders, etc.

There are several unclassified specimens of the Urodela—and I think it is to this order that H. W. M.'s specimen belongs.—I. A. B., Berwyn, Ill.

Try This Revolving Cage

HERE is a problem I would like someone to work:



In a fixed roller bearing *A* (diameter three inches), a shaft *S* (diameter two inches) revolves upon rollers *R* (diameter one half inch), which turn in a cage *C*. How far will the cage turn while the shaft is making one complete revolution?—J. B., Bozeman, Mont.

Another Way of Saying It's Push, Not Pull

FOLLOWING an article which appeared in P. S. M. some time ago, there seems to be a little misconception in regard to the wings of an airplane. The trend of the article was approximately this: a partial vacuum is created by the curve on the upper surface of a plane's wing and the resulting suction affords two thirds of the lifting force. R. A. L. gave a wise retort in January's number. But since the same error has appeared in several other periodicals lately, I take this opportunity to offer a solution.

First the ancient idea that Nature abhors a vacuum must be discarded.

Pressure is exerted upon the underside of a plane's wing due to the atmospheric pressure from beneath. This would be increased also by the force of the wind. If there is a partial vacuum on the upper wing surface, there is no opposing force, and the wing is pushed upward—from beneath. Therefore the total pressure or lifting force is on the under surface of an airplane's wing. This is merely the simple application of a law of physics. I hope the obsolete theories will be forgotten and this solution accepted.—T. R. L., Worcester, Mass.

Where's the Joke?

MICHEL MOK'S recent article on "New Clues to the Mayan Riddle" is certainly a joke. It seems to me he just came to life, or perhaps the fuss was because it was the first time Lindbergh saw the Yucatan ruins. I think that Colonel and Mrs. Lindbergh and some of their friends received a vacation all dished out in first-class order. He didn't discover anything new. The only thing new was that it was the first time Lindbergh had seen them.—B. Z., Bluff City, Kan.

Just a Little Dip into Infinity

SPEAKING of problems, I have an easy one which I am sending you:

An automobile went around a mile track, the first time in one minute. Every lap following it went in two seconds less time. How many trips would it make and how long would it be before it would go around the track in no time at all?—A. C. K., Attalla, Ala.

Just Eager Waiting

EAGERLY every month I await the arrival of your magazine. Your Home Workshop articles are great and I am especially interested in the new series of splendid and delightful models Captain McCann is presenting.—J. W. K., Marietta, Ohio.

After All, You Know, You Can't Blame Father

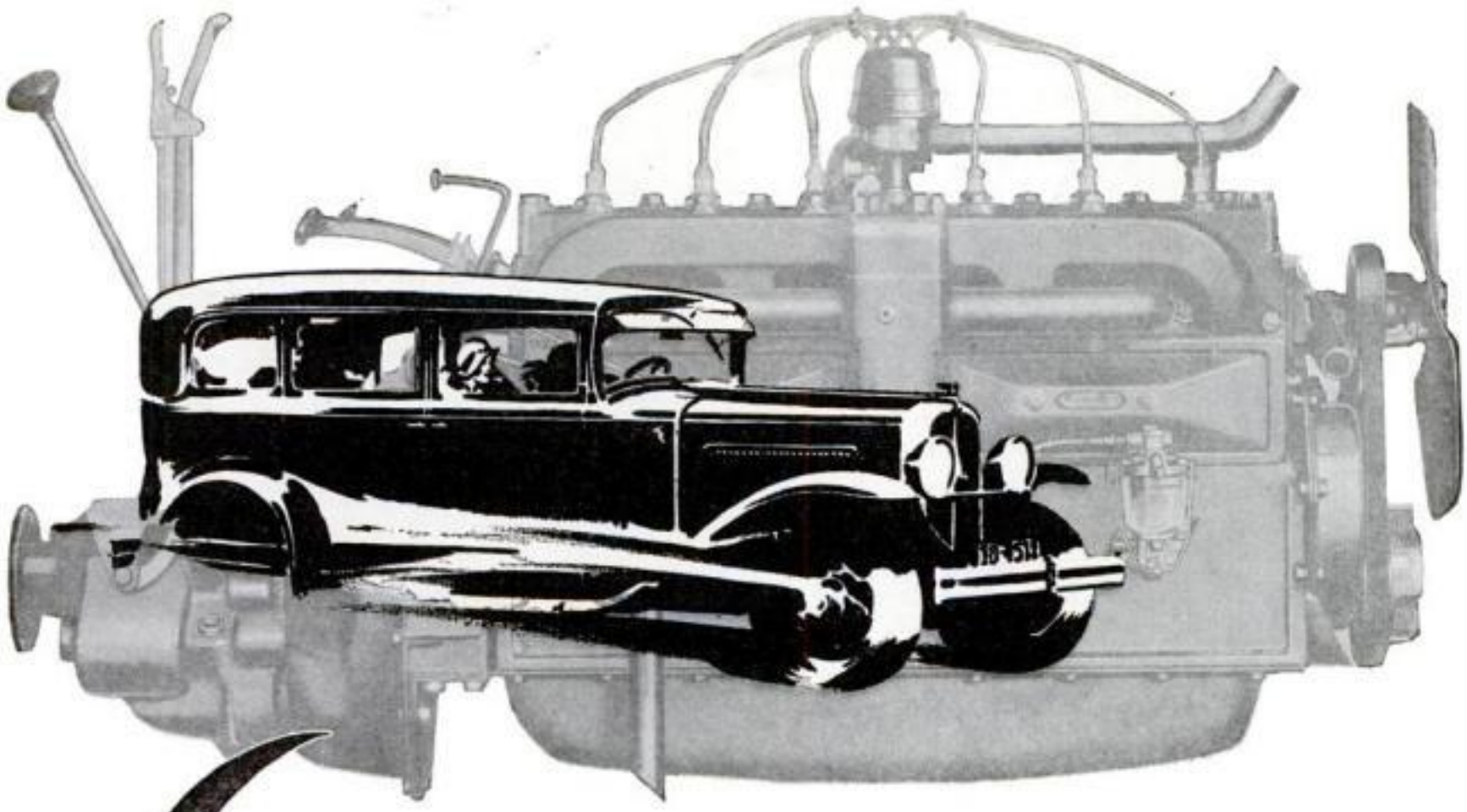
SOME of the reasons why I *don't* like your magazine are: My father brings it home and there is such a rush for it that I never get to see it. Then when I do, it has so many interesting articles in it that would just do for my general science notebook at school, and my father won't let me have them! He says it's such a good magazine that he'll punish the one that cuts it up. So I wish I had never seen your tempting magazine, or that you wouldn't put such good articles in it. —"Tempted," Canal Zone.

If They Didn't Quarrel Why Start Things Now?

I QUITE agree with H. L. R., of Richmond, Va., in his letter *re* the invention of the electric incandescent lamp, and beg to amplify it.

Sir Joseph Swan, of Newcastle-on-Tyne, obtained his patent for an incandescent carbon filament lamp at least twelve months before Edison, and the lady who helped him died recently in England at eighty-four years of age.

There was much discussion between the two inventors as to priority of patent, and Swan eventually came to the United States. The result was he and Edison shook hands, and the



60 horsepower . . the biggest engine used in any six of its price

In its remarkably sound and sturdy engine you will find a typical example of the extra value offered by the New Series Pontiac Big Six. This fine power plant is the biggest used in any six of Pontiac's low price. It develops 60 brake-horsepower which accounts for Pontiac's exceptional swiftness, tremendous power on hills and flashing acceleration.

Pontiac has a moderate speed engine, achieving its great power output at only 3000 r.p.m. As a result, the New Series Pontiac Big Six is exceptionally dependable and economical, for its power plant gets less wear per mile of driving, and therefore lasts longer. Maintenance cost is reduced to a minimum as a result.

Notable features of the Pontiac engine are its big durable bearings, the sturdy crankshaft which has the Harmonic Balancer to counteract torsional vibration, full pressure lubrication, crankcase ventilation which prevents condensed water vapor from diluting the engine oil, and the new rubber mountings which assure smoothness of operation by insulating the engine from the frame.

If you are mechanically inclined, you will enjoy an inspection of Pontiac's big engine. Mechanical-minded or not, you will get a real treat, we believe, from a trial drive. Note also the new riding comfort afforded by its improved Lovejoy Hydraulic Shock Absorbers—the new ease of control in its roller bearing steering system. Balance all these features—including its economy of operation—against its low price and you will then appreciate the great dollar-for-dollar value offered in the New Series Pontiac Big Six.

Prices, $745 and up. All prices f. o. b. Pontiac, Mich., plus delivery charges.

Oakland Motor Car Company, Pontiac, Mich.

A FAMOUS NAME A FINER CAR

THE NEW SERIES

Write for an interesting booklet which illustrates and describes the design of the New Series Pontiac Big Six

PONTIAC BIG SIX $745 AND UP

PRODUCT OF GENERAL MOTORS . . . BODY BY FISHER

first lamps they jointly produced were known as "Ediswan." The "Ediswan" company still exists. Why should not credit be given where credit is due? Swan is never mentioned on this side of the water.—S. W. R., Ottawa, Canada.

Would Pin a Medal on Us

YOUR announcement of a $10,000 prize and a gold medal to be awarded for the achievement in science of greatest value to mankind interested me greatly. As an old reader may I offer the suggestion that not the least achievement in the world of science has been the recent popularizing of science, the awakening of the mind of the layman to the tremendous part that science plays in his life? In this work POPULAR SCIENCE MONTHLY has played a leading part. You need not go beyond your own office in your search for a deserving candidate for your award.—L. L. F., Jr. Rochester, N. Y.

As Fast as Possible

I HAVE been a reader of this magazine for several years and I think it is getting better every issue. I am greatly interested in furniture designs and models of all kinds. Give us more of them.—C. E. C., Westminster, Md.

Perpetual Motion Is Killed Again

IN A RECENT number of POPULAR SCIENCE MONTHLY Mr. S. P. N. R., of Dayton, Ohio, wants to know what would prevent an overbalancing perpetual motion wheel, one side of which was insulated against gravity and the other side not, from turning. Here is the answer: The same natural law that keeps the moon from turning would also keep the wheel from turning. If you, Mr. S. P. N. R., had made the trip around the world on board the *Graf Zeppelin* with your overbalancing wheel, you would have found it out.—G. H., Cotulla, Texas.

Scotland Wants a Ship in a Bottle

I AM at last doing what I meant to do a few years ago—write to congratulate you on the splendid articles you publish in POPULAR SCIENCE MONTHLY.

Through the kindness of a friend in the U. S. A., I have been able for the past three years to read and enjoy P.S.M. every month. I have read every page and have derived much knowledge from doing so.

I take this opportunity to congratulate Captain McCann and the Radio Editor on the clearness and simplicity of the reading matter and the drawings in their departments.... I wonder if I am asking too much when I ask if you will publish drawings and explanatory matter for the making of an old-time sailing ship *in a bottle*. That is one of the things I've long wanted to make.—A. McS., Renfrew, Scotland.

Was the Ant Crazy?

WHAT establishes the synchronism of the ant and the turning of the log to cause that ant to travel the length of the hypotenuse of a right triangle with sides twelve and five feet respectively equaling thirteen feet? Einstein states that there is no such thing as a straight line; then how in the world can the lowly ant trot a straight line on a rolling circular plane arriving at the end of the log at the instant of stopping. Scientifically absurd.—H. F., Tullahoma, Tenn.

Delightful, But— Not Surprising

AS AN indication of how I value your magazine, I may state that for a number of years I have followed the practice of clipping and indexing all articles which are likely to prove of value to a man who owns a house and car and who is forever "making things." I find that I get more such articles from POPULAR SCIENCE in one issue than I do from any other magazine in ten or twelve.—F. G. S., Ottawa, Canada.

What a Memory!

ANTHONY FOKKER claims to have made the largest land plane ever built. On page 57 of the July, 1928, issue of POPULAR SCIENCE MONTHLY are two pictures of a giant all-metal trimotor plane built and flown in England. It has a 150-foot wing spread and seven-and-a-half-foot wheels. The Fokker had, I believe, something like a 96-foot wing spread. The craft is called the Beardmore *Inflexible*. It weighs fifteen tons and has a total of 1,950 horsepower. Am I right?—W. B., Palo Alto, Calif.

The End of Colds

AS MY contribution towards science I offer as a positive and absolute preventative of "bad colds" the constant and persistent habit of breathing deeply and exclusively through the nose. Cold germs, microbes, and the like cannot get a foothold or thrive and endure in fresh air. The remedy, then, is to keep the mouth shut and breathe exclusively through the nose.—N. L. F., Walhalla, S. C.

Why a Skyscraper Record?

THAT letter from J. A. O. on the need for rules for skyscraper records has a point. In New York City, two new buildings are nearing completion. It was claimed that each would be the tallest in the world. During the summer, the plans for both buildings were altered secretly on two occasions to add a few feet to the height. In the end, after it was too late to change again, one skyscraper tacked on a steel *spire*, 185 feet high, and carried off the palm. I'm hoping the other building will put up a spire with a lightning rod at the top and cop the victory.—E. F. W., New York City.

His Two Motors Pulled Full Load

IN THE January issue I noticed an inquiry by A. E. W., Ada, Ohio. I solved the same problem in the following manner.

I took two motors of the same type and speed and then disconnected the starting coils on one motor. I got a three-inch pulley with set screws on each end. The motors were then connected together as in a motor generator set. They were mounted on a base with the pulley in the center. Both motors were wired in parallel.

By using this method one motor starts them both and when they are up to speed both are pulling full load.—L. G. S., Boise, Idaho.

Will the Air-Minded Answer This Attack?

THE airplane, as a *safe* means of transportation, is, and always will be, in my humble opinion, a failure.

This statement will be greeted with jeers by many of the readers of POPULAR SCIENCE MONTHLY, but let us consider the matter from a coldly practical viewpoint, guided by experience and the laws of probability.

Conceive, if you can, of a monorail New York Central Railroad system. As long as a train is in motion it maintains its erect position, but when it stops, it falls over except where provision is made for holding it upright. Therefore at each station auxiliary rails are provided which engage wheels on the sides of the train. These rails extend outward from the station a sufficient distance to permit the train to attain a speed of, say, thirty miles an hour. The monorail track extends from city to city, in a cut or on a fill, according to the nature of the terrain.

Imagine yourself on a monorail train *de luxe*. Everything is lovely until something happens which necessitates a stop between stations. Of course, nothing of that nature is supposed to happen, but for some obscure reason it does happen. The train will topple over and probably several will be killed.

Does any reader of POPULAR SCIENCE MONTHLY think people would trust their lives to such a railroad system? To determine the value of the airplane as a means of *safe* transport, just substitute airplane for monorail train in the foregoing description. Does it sound like a safe way to travel? Are you willing to trust it? But keep your eye on those lighter-than-air ships they're building down at Akron!—H. H., Mattoon, Ill.

Eyeglasses the Penalty for Civilization

I WAS interested in the letter "Too Many Eyeglasses?" K. N. B. raises an interesting question.

It is most likely that the eye structure varies little from that of our early ancestors. Further investigators are agreed that the human eye was primarily adjusted for viewing objects several feet or more from our eyes. Under the stress of modern conditions our eyes are being used at near distances, say thirteen to sixteen inches for a great part of the time. Nature has made some physiological adjustments for these changing conditions but in many cases the changes have not been sufficient to meet the needs. Thus the use of glasses is one of the penalties which we pay for our civilization.—G. H. A., Houston, Texas.

Would Esperanto Help the Talkies?

IN YOUR editorial about the impossibility of sending American talking films to foreign countries you ask for a solution to the problem. It is hard to answer, but consider this proposition: In the International Auxiliary Language, Esperanto, every letter has everywhere and in every manner the same sound. The language can be learned in a very short time and a vocabulary of 500 words is enough.—L. E. McK., Altoona, Pa.

"Why Frank—how disgusting!"

Note to Medical and Dental profession:
When prescribing a mouth wash for *germicidal* purposes, please make certain that it is a germicide: and not merely a preparation which is only deodorant and astringent.

IF you, or any member of your family have the slightest evidence of dandruff, we urge you to try this treatment, which has benefited thousands:—

Simply douse Listerine, full strength, on the hair. Vigorously massage the scalp forward, backward, up and down. Repeat this treatment for several days, using a little olive oil in case your hair is excessively dry.

You will be amazed at the speed and thoroughness with which Listerine gets rid of dandruff. Even severe cases that costly so-called "cures" failed to improve, have responded to the Listerine method. We have the unsolicited word of many to this effect.

There is no mystery about Listerine's success used this way.

Dandruff is an infection caused by germs. Full strength Listerine is powerful against germs—though so safe it may be used in any body cavity.

Indeed, Listerine's germicidal action is so intense that it kills 200,000,000 of the virulent S. Aureus (pus) and B. Typhosus (typhoid) germs in 15 seconds—both noted for their resistance to antiseptics. Yet its effect on tissue is healing.

Naturally then, Listerine is effective against other infections of lesser nature. Use it at the first sign of dandruff. Lambert Pharmacal Co., St. Louis, Mo., U. S. A.

LISTERINE gets rid of dandruff

The safe antiseptic *Kills* 200,000,000 *germs in* 15 *seconds*

How it sounds to your NERVES

The rattling din of typewriters in busy offices . . . the shrill jangle of telephones . . . slamming of doors and drawers . . . the constant hum of conversation . . .

These distracting noises bite into nerves worn raw from the strain of business routine. They encourage costly mistakes . . . hamper the clear thinking of people paid to think.

PERMANENT QUIET FOR YOUR OFFICE

HUNDREDS of progressive business men have found an easy way to subdue this annoying din. By applying Acousti-Celotex to their office ceilings they have succeeded in subduing noise — in raising the efficiency of their entire organization.

Acousti-Celotex is a noise-absorbing cane fibre tile that comes in rigid units which are quickly applied to the ceilings in old or new buildings. The natural buff color and trimness of these units add to the beauty of any office.

Acousti-Celotex is easily cleaned —the upkeep cost is low. If desired, it can be painted and repainted even with lead and oil paints to conform with any decorative plan, without loss of its sound-absorbing value.

Hospitals use Acousti-Celotex to produce the restful quiet that speeds convalescence. Schools apply it to classroom and assembly hall ceilings to subdue distracting noises and reverberations. Churches and theaters use it to assure proper acoustics.

Mail the coupon below for additional information.

The Celotex Company, 919 North Michigan Avenue, Chicago, Illinois. Mills: New Orleans, Louisiana. Branch Sales Offices in many principal cities (See telephone books for addresses). In Canada: Alexander Murray & Co., Ltd., Montreal.

The Celotex Company maintains an acoustical engineering service with which all architects are familiar.

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FOR LESS NOISE—BETTER HEARING

THE CELOTEX COMPANY Pop. Sci. 5-30
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Gentlemen: Please send me further information on the use of Acousti-Celotex.

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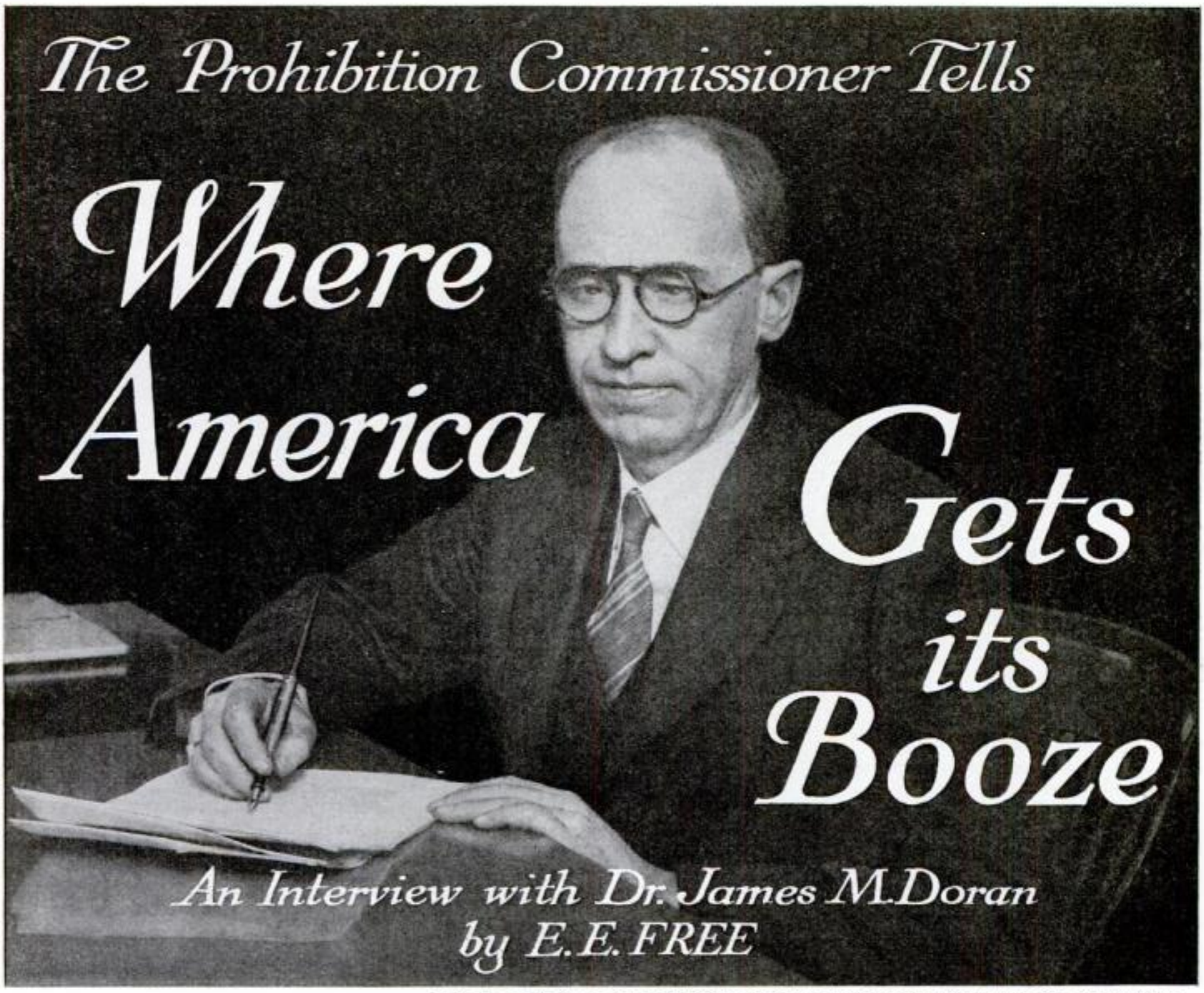
Popular Science Monthly

MAY, 1930 TRAVIS HOKE *Editor* VOL. 116, NO. 5

The Prohibition Commissioner Tells Where America Gets its Booze

An Interview with Dr. James M. Doran by E. E. FREE



Dr. James M. Doran, head of the Treasury Department Unit for enforcement of the Volstead law.

BOOTLEGGERS are the only people in America who have adjusted themselves completely to prohibition. Providing America with alcoholic drink is now a well organized business with an income estimated at over three billion dollars a year. It has its executives, its salesmen, its technical experts and traffic specialists, its lawyers, its financiers, even its code of ethics. It is illicit, under cover, but not unrespectable; only some of its lesser hirelings are that. Its existence is an economic and industrial fact to be reckoned with.

Alcohol for the bootleg trade is now made, thousands of gallons at a time, in great fermenting vats and modern rectifying stills. No chemical engineer would be ashamed to own this equipment as the product of his skill. There is a good reason for this, as the present bootlegging industry is able to hire and, I am informed does hire, to direct the industry's operations and design its equipment some of the ablest technical experts on fermentation and distillation.

A FEW weeks ago in Springfield, Illinois, two of the country's largest and most respectable industrial concerns, the Fleischmann Yeast Company and the Corn Products Refining Company, were indicted for conspiracy in furnishing, the Federal grand jury alleged, yeast and corn sugar to illicit distillers of alcohol. The point is not the guilt or innocence of these concerns in selling their products or in knowing how their products were to be used. The significant thing is the nature of the materials referred to. Millions of pounds of sugar are being diverted, it is charged by the Government, into this new, enormous industry of illicit fermentation and distillation.

IN 1929 prohibition authorities raided nearly sixteen thousand distilleries and seized over eleven thousand stills, many of them giant affairs two or three stories tall. Houses looking like private dwellings on the outside are found to have been gutted, the tall columns of stills run from basement to attic, fermentation vats holding thousands of gallons installed, and the whole interior converted into a modern, not inefficient alcohol factory. Other stills by hundreds have been built in old, converted factories; in garages with the still columns, which

The size of these raided stills shows big capacity for production of alcohol.

must have height for good operation, cut through the floors from basement to upper stories; even in farmers' barns, where the tall cylinders of adjacent silos make excellent places for the columns of the stills.

THIS increasing industrialization of illicit alcohol was the burden of the answer made by Dr. James M. Doran, well-known chemist and now United States Prohibition Commissioner, when I asked him to tell me for POPULAR SCIENCE MONTHLY where America's booze is coming from. I have confirmed the Commissioner's statements from many sources. I have asked officers of agencies opposed to prohibition, police officials, prohibitionists, Congressmen, bartenders, bootleggers, and court officials who deal frequently with prohibition cases. All opinions are the same. Dealing in illicit alcohol is big business and is organized as such.

This fact is changing the ways of getting alcohol. When prohibition went into effect, Dr. Doran told me, there was much liquor in storage in bonded warehouses and similar places. Owners were allowed to retain this liquor, for medicinal sale or for any other legal use. At that time, too, bootlegging and illicit manufacture of alcohol were new businesses not yet organized.

THESE facts combined to direct the first flow of illicit liquor out of warehouses into the hands of small, ill-organized distributors. Stores of whisky and other liquor were rifled, with or without the consent of the owners; guards were bribed; individuals even went so far as to buy whole warehouses full of other people's whisky, and then steal the property for which they were responsible, cheerfully paying damages when they fell due, as the profit on illicit sale was greater than any possible legitimate damages.

This first phase of the bootleg industry lasted, I gather from statistics and other facts presented to me by Dr. Doran and his officers, for two or three years after the new law went into effect Jan. 16, 1919. By 1922 or 1923 most of this stored liquor was gone. The former legitimate distilleries were closed. All the warehouses either were too well guarded by honest officials to be reached or already had been rifled of their contents. The budding illicit industry needed a new source of supply.

This was found in denatured alcohol. Alcohol is one of the world's most important industrial chemicals quite aside from its use in beverages. Even before prohibition, the production of alcohol for the manufacture of extracts, drug compounds, lacquers, antifreeze mixture for automobiles, and other chemical uses far exceeded its use in whisky and practically equaled the amount of alcohol drunk in wine and beer. Nowadays the American chemical industry has so far expanded that it uses nearly twice as much alcohol as was distilled for use in beverages—except beer—before prohibition went into effect.

Even before 1919 much of this industrial alcohol was "denatured," that is, chemicals were added to give it a bad taste or a bad smell or to make anyone who drank it ill. In those days this was done to make such industrial alcohol exempt from the tax laid on alcoholic beverages. Little time was wasted in an effort to make these original denaturing formulas proof against reconditioning of the alcohol, as no chemist, at that time, could have any object in taking the trouble to remove these evil tasting things from cheap denatured alcohol, since he could buy good alcohol for only a few cents more, an amount consonant with the federal tax.

When the supply of illicit whisky stolen from warehouses began to grow short, the bootlegging industry, as Dr. Doran told me the history, turned to this denatured alcohol. Chemists had no great difficulty in removing the added materials from the denaturing formulas then in use, leaving reasonably pure alcohol. Gradually this alcohol began to replace, in the bootleg market, the materials stolen from the warehouses. It is not necessary, the uninitiated should be informed, for a bootlegger to have whisky, gin, brandy, and all the rest in order to supply his customers with what they want. Any liquor and many wines can come out of the same alcohol barrel.

Moonshiners in the mountains of the South always made booze, but under prohibition they have increased their operations enormously as is shown by these stills which can turn out five gallons of alcohol in eight minutes.

THERE is great outcry at present about "synthetic gin," yet seldom has America seen anything else. Real gin is generally supposed to be made by fermenting the berries of the juniper and distilling the product, just as whisky is made by fermenting and distilling a "mash" of water and grain, or brandy by fermenting and distilling grape juice, or rum by fermenting and distilling a mixture of sugar and water. That was the theory about gin.

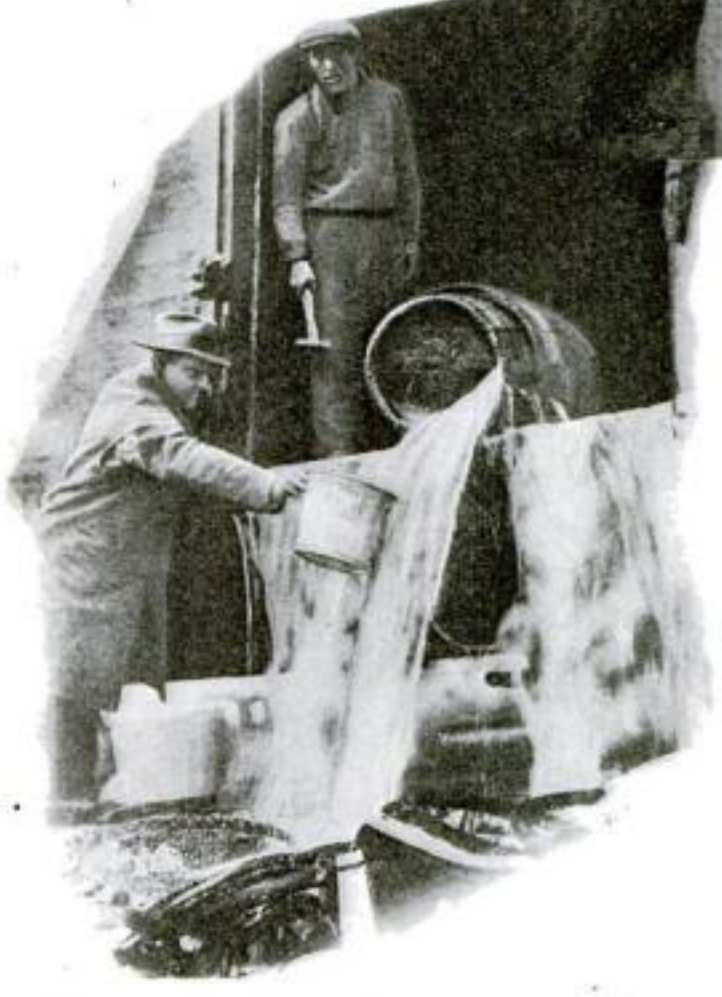
Once, before prohibition, I tested (being then a practicing chemist) one bottle of gin which apparently had been made in that way. But then, as now, virtually all the gin drunk in America, no matter how foreign and pretentious the label, was made synthetically out of juniper oil, other flavoring matters, and alcohol.

The blending, it is true, was better than now and sometimes the blended product was redistilled or aged to improve the flavor; refinements which the present-day industry has not yet reached. But all American gin, practically speaking, was just as "synthetic" fifteen years ago, before prohibition, as it is today.

Also it was very little more wholesome, for one thing that the present well-organized bootlegging industry has learned is that it is not good business to poison one's customers. Little of the booze now on the American market is really unwholesome, assuming that *any* booze is wholesome.

Probably there were about as many instances of poisoning from bad liquor in preprohibition days as now. At present, at any rate, it is chiefly not poisons but alcohol, just the same as it always was, that sends heavy drinkers to the hospitals and the casualty lists.

A high-class bar of preprohibition days. Distilleries and breweries furnished the liquor for such bars, but even then, it is said, most of the booze was no better than the modern bootleg brands.



This carload of illicit beer, seized and dumped by prohibition officers, suggests the quantity now being made.

AS TO taste, it is not possible to congratulate the present industry so highly. Today not only the gin, but the whisky, brandy, liqueurs, and other drinks are made from raw alcohol "cut" with water, which merely means diluted, and then flavored with special mixtures of chemicals, plant extracts, or other materials to make the final liquid taste like Scotch, rye, absinthe, or whatever the trade demands. There is nothing new about this. Liquors have been made that way for years.

I am not sure that it is not just as good a way as any to make these materials. One reason why the Scotchmen on their moors and the Irishmen on their peat bogs made whisky in the traditional ways was that they had no alcohol and no way of making it, except by mixing malted grain with water and then setting it aside letting nature take its course.

Probably the present method of making all these things to order out of cheap, easily stored extracts and raw alcohol must be considered an industrial improvement. Great store used to be set on "aging," and it is true that to keep a raw distilled liquor in a wooden barrel charred to charcoal on its inside does destroy, in the course of time, certain chemicals, like fusel oil, which may exist in natural whiskies distilled from fermented grain. Though that is an advantage for real whisky, it can do synthetic whisky little good. If the maker starts with pure alcohol, dilutes it properly, and adds nothing harmful, accidentally or otherwise, aging will not make the resulting whisky, gin, or brandy a better or less harmful drink.

Anyway, the present bootlegging industry makes and distributes a very fair quality of booze, virtually all made synthetically out of raw alcohol. In 1923, and for a few months thereafter, this alcohol was coming, I have explained, from the chemical reconditioning of the various kinds of denatured alcohol then on the market for legitimate industrial purposes. Up to that time, the activities of the Governmental enforcement officers had been devoted largely to guarding the warehouses and trying to catch the thieves. As the source of supply shifted, the prohibition officers shifted around too, and arranged to make more and more difficult the reconditioning of the denatured alcoholic materials.

Dr. Doran admits, and every chemist will agree, that it is quite impossible to put into alcohol any poison or other denaturant that another chemist cannot remove. Chemical analysis, to which the majority of chemists devote their lives, consists in just this taking apart of different chemical substances after they have been mixed. But what the prohibition authorities could do and did do with the denaturing formulas was to make them more difficult and more costly to take apart.

Most of the denatured alcohol now sold, for example, is made according to an approved formula known as number five. Of this alcohol, intended chiefly for antifreeze mixture in automobile radiators, forty or fifty million gallons are sold each year; about as much alcohol as was in all the whisky, gin, and other hard liquor sold before prohibition. This material contains, as the denaturants added to the pure alcohol, about four percent of wood alcohol, a small amount of kerosene or gasoline, and a similar small quantity of a special denaturant called Aldehol, which is composed of certain simple chemicals that are related to alcohol itself but are not drinkable.

IT IS possible to take these denaturing materials out of the alcohol again and leave the latter reasonably pure. All that is necessary is a large and complete distilling system, a skilled chemist, plenty of time, and the labor, fuel, and patience necessary for redistilling the material over and over again, sometimes from certain added chemicals, until all of the harmful substances have been removed. That is precisely what a chemist does, in fact, when he wants to analyze one of these denatured mixtures.

The only trouble with this procedure, from the viewpoint of the bootleg barons, is its cost. No industry will buy its raw materials in a dear market if it can find a cheap one; and that brings us to the present period of big-business bootlegging.

By 1926 or 1927 the efforts of the prohibition authorities to tighten up the formulas for dena- (Continued on page 146)

Battery of cameras that photographed *Song o' My Heart*, in which John McCormack is starred. Note the large "Grandeur" camera in the center. All cameras are muffled to still the sound of their mechanism. In foreground, Mr. McCormack and Frank Borzage, director of the film.

New Ideas Sweep Movie Studios

By MICHEL MOK

"IN A year and a half all motion pictures will be wholly or partly in color. Three years from now the black and white photoplay will be as rare as the silent picture is today."

With these words, the head of the production department of one of America's largest motion picture corporations recently gave me a glimpse into the literally brilliant future of the film industry.

His prediction was based upon a new and revolutionary development in picture making. Producers have discovered that the public is enthusiastic over color and that it means money at the box office. Hence, "color" is the watchword in the world of the cinema today, just as "sound" was three years ago.

Four all-color musical motion pictures, photographed and printed by the so-called technicolor process, are attracting huge audiences on Broadway, New York City, as this is written. Many other talkies and "singies," mainly in black and white, have tinted sequences. A year ago *On with the Show*, the first all-color talking and singing picture, started the color rush. This year no fewer than 100 feature-length pictures, entirely or partly in color, will be shown in theaters throughout the country.

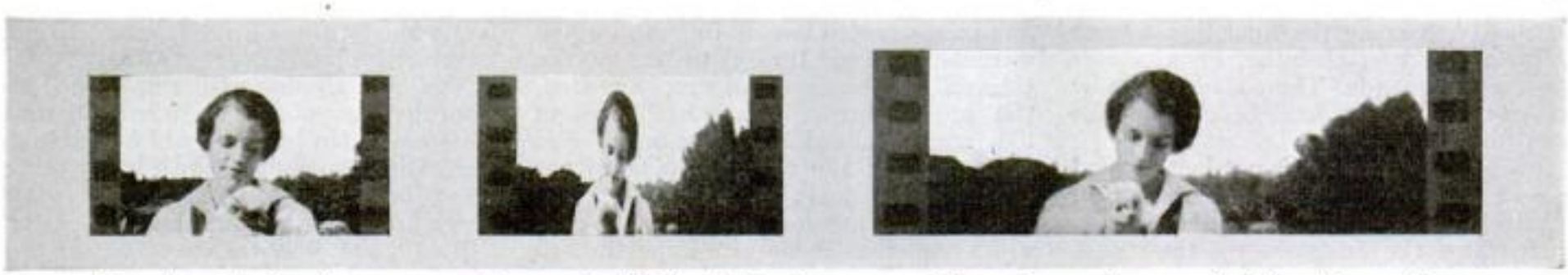
To meet this heavy production schedule, the Technicolor Corporation, which makes the colored movies for the various producers, has just completed a fifth large plant in Hollywood. It has two other laboratories in the picture colony and two in Boston, Mass. Eventually the new plant, costing more than $1,000,000, will have a capacity of 47,000 feet of colored film a day or about 14,000,000 feet a year, enough to prepare more than 2,000 prints of feature films, the average length of which is 6,500 feet.

ALL of the technicolor plants are working triple shifts and thirty special technicolor cameras, operated by trained crews, are rushed from studio to studio and kept grinding night and day.

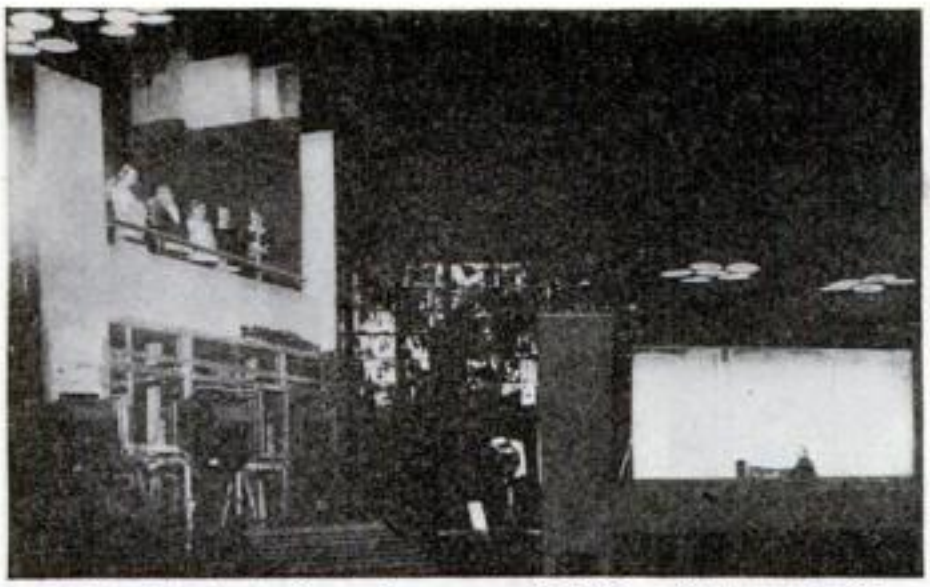
This sudden demand for color pictures is a direct outcome of the great success of the talkies, which, begun in 1927 as a desperate experiment by a producer who was in financial straits, are now presented in 12,000 of the 20,000 moving picture theaters of the country. Sound pictures, it is claimed, have added more than 10,000,000 persons to the weekly cinema audience of the United States and increased receipts thirty-five to forty percent. But sound did more than that. It answered the old question: What is wrong with the movies? It was this: the public was tired of the silent films. The saturation point had been reached; the industry was stagnant. It needed a new and vivid element of appealing interest.

THIS is the lesson the producers have taken to heart. They are not to be caught napping again. And there is sound reason for their watchfulness. According to statistics recently compiled by the International Labor Bureau, at Geneva, Switzerland, $4,000,000,000 is invested, throughout the world, in the moving picture industry. Of this staggering sum, half belongs to American concerns.

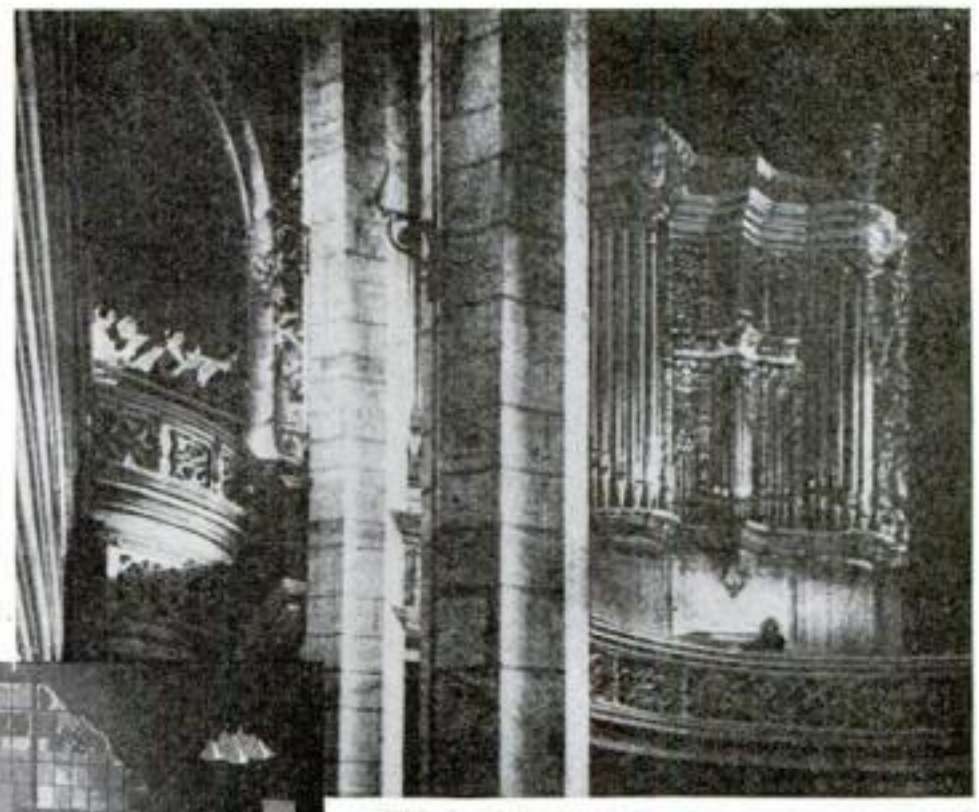
Movie men, therefore, are eager to add to their bag of tricks any potentially successful new development. Recently there have been other revolutionary innovations aside from color. One of these is the greatly enlarged picture, taken on wide film and projected on a huge screen. This was introduced to New York a few weeks ago when the Roxy Theater gave the first showing of *Happy Days*, a so-called "Grandeur" production made by



How pictures for the wide screen are made on standard film by the Douglass process. Left, a picture made on standard film with an ordinary lens. Center, same scene shot with lens that compresses wider angle of view on film. Projected with special lens, this appears as at right.



This is what the studio people saw as a Schufftan picture was being filmed. The members of the choir and organist were in place in the set.



This is what the audience saw when the optical mirror picture, at left, was thrown on the screen.

the Fox Film Corporation. Photographed on film seventy millimeters wide, twice the standard width, this giant photoplay was flashed on a screen forty-two feet wide, filling the entire breadth of the Roxy stage. The ordinary screen is twenty-four feet wide and eighteen feet high. Grandeur films add twenty-five percent to the height of the picture.

PRODUCERS do not claim that Grandeur pictures are three-dimensional, which they decidedly are not, but they do say, and justly, that they create a somewhat stereoscopic effect. There are two factors that cause this illusion. First, it is more natural and comfortable for the eyes to take in a scene spread on a wide surface than one on a narrow one. Secondly, the edges of the picture, because of the great width of the screen, are less obtrusive or entirely eliminated.

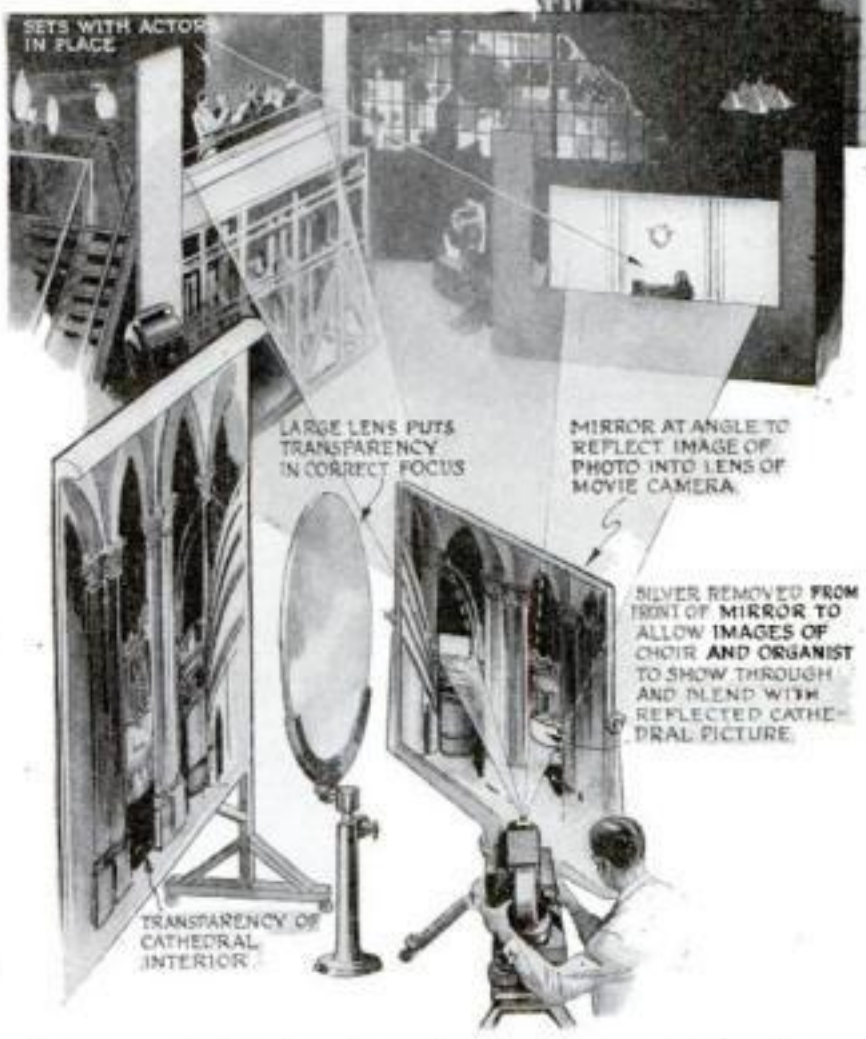
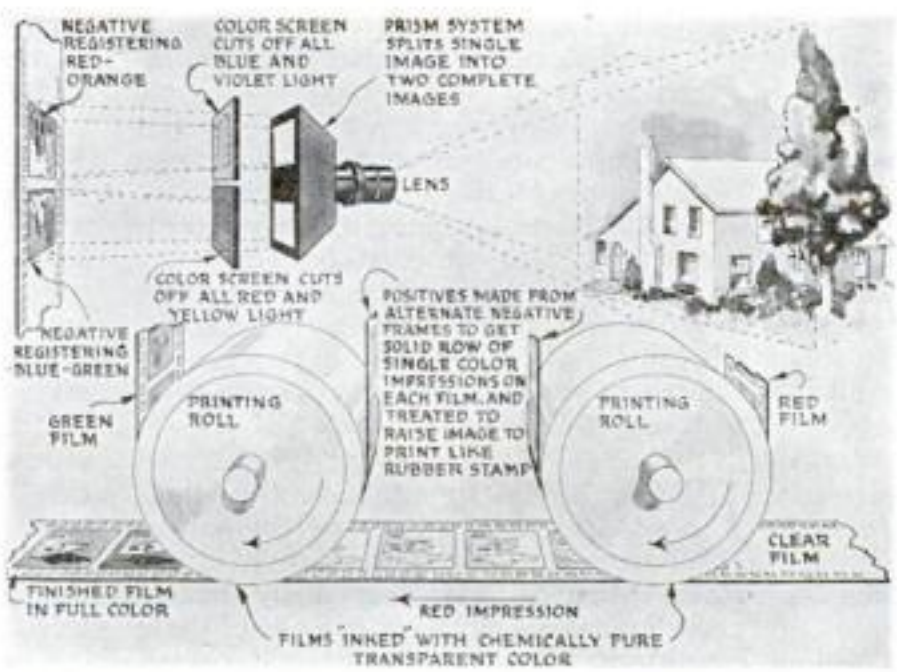


Diagram makes clear how the studio set shows through the mirror with silver removed so its image can blend with the reflected picture.

The new wide film has two real advantages. Because of the greater territory covered, more persons can be shown clearly on the screen at once. This is especially valuable in the now popular picturized musical comedies, in which big groups of chorus girls and dancers are presented. For the same reason outdoor panoramic views become more effective and beautiful. The second advantage is that the width of the film allows for a wider sound track. One tenth of an inch is all that can be allowed on standard film. On Grandeur the sound track is one quarter of an inch wide. This produces a better sound quality and requires less amplification. Also less magnification of the picture itself is necessary, resulting in sharper and less "grainy" images.

Naturally, the next step will be a combination of color, wide film, and sound. From reports current as this is written, it seems likely that, outside of New York City, the "high, wide, and handsome" pictures will not be shown for some time. The reason is that the "big four" of the industry—Fox, Paramount, RKO, and Warner Brothers—as yet have not agreed on the exact width of the enlarged pictures. Such agreement is essential because presentation of the big movies will force the theaters to acquire new equipment such as projection machinery and screens. In many cases introduction of wide films would even entail the remodeling of the stage or the entire house.



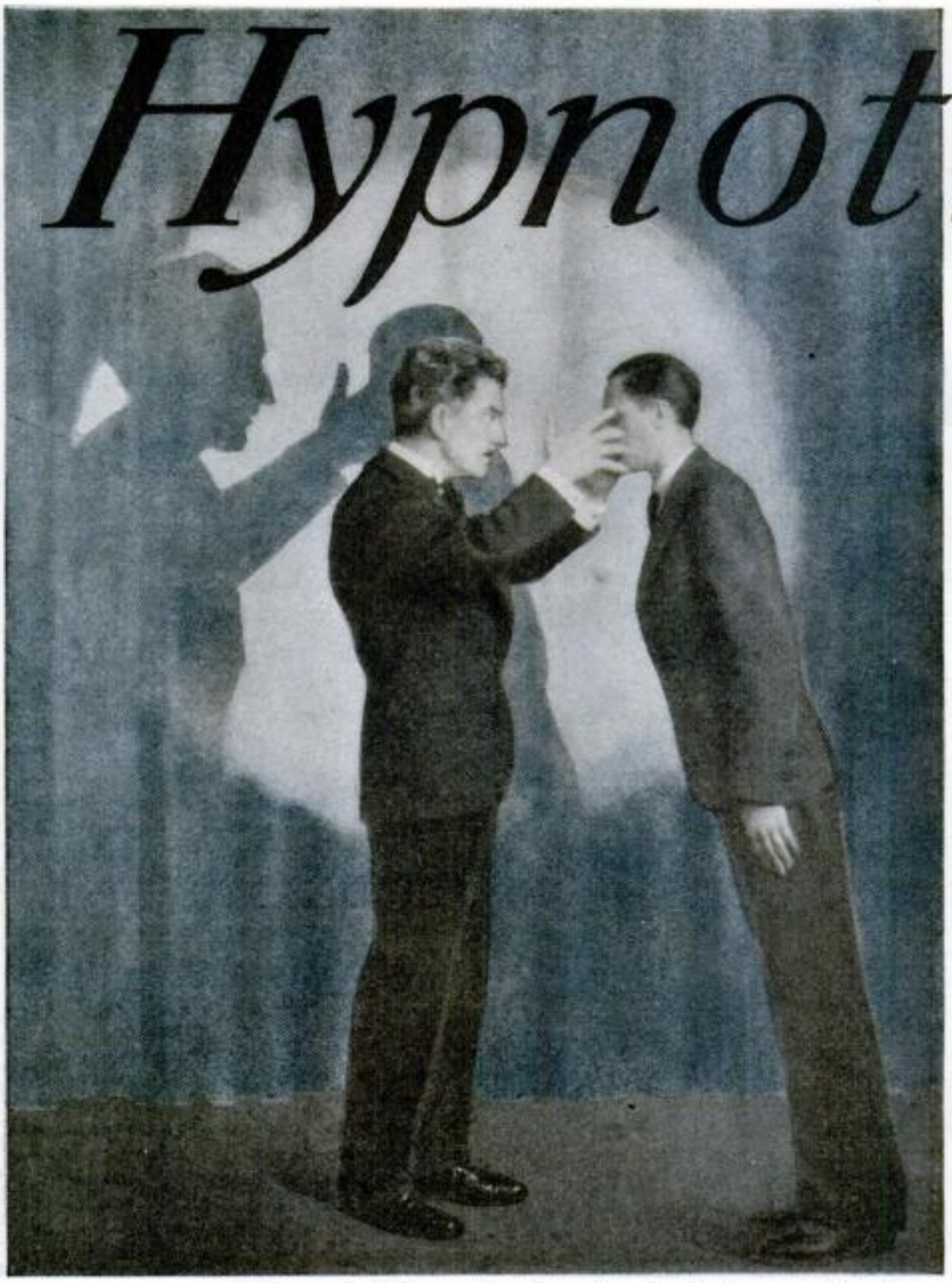
A simplified diagrammatic explanation showing, step by step, the principles of the technicolor process from the studio shot to the finished film.

THE Fox organization, the first to release a wide picture, insists on a seventy millimeter film. On the other hand, the Spoor-Bergren film, controlled by RKO, is sixty-five millimeters wide. What width the other two concerns favor is not known, but their opinions, too, seem to be divided. Moreover, the big producers are reluctant to saddle the additional cost of wide picture equipment on the exhibitors, many of whom are carrying heavy financial burdens due to recent installation of apparatus necessary to present sound pictures.

For the time being, probably the only novelty at your favorite movie house, unless you happen to live in New York City or in Hollywood, where one theater also is equipped for the showing of Grandeur features, will be color pictures. To be exact, it will be the only development you will be able to see from your seat in the theater. But "behind the screen," or rather, in the studios and laboratories, new tricks of movie magic are being introduced to improve photoplay quality and by cutting the cost of production, increase the number of fine pictures.

The Bell Telephone Laboratories in New York City, which were the greatest factor in making sound pictures possible, having developed two of the three principal talkie devices now in general use, are seeking constantly to improve their products. Their latest

(Continued on page 143)



Hypnotism

Fake, *says a magician replying to a scientist who calls it* Real

By

HARRY BLACKSTONE

IN OUR March issue, Wesley R. Wells, professor of psychology in Syracuse University, gave his views on hypnotism. Harry Blackstone, the famous magician, read Professor Wells' article and sent us the following comment. Since it is the policy of POPULAR SCIENCE MONTHLY to open its columns to those who have made independent research in any field of science, we present Mr. Blackstone's reply as an interesting exposition of the other side of a much-disputed question.

The hypnotic "falling test," as demonstrated by Blackstone. He describes this stunt as merely a case of lost equilibrium on the part of the subject.

WHAT is the truth about hypnotism?

To this question Wesley R. Wells, professor of psychology in Syracuse University, has given, in the March issue of POPULAR SCIENCE MONTHLY, an answer with which I emphatically disagree.

Patient investigation of all kinds of so-called hypnotic phenomena has convinced me that there is only one correct answer and it is this: The truth about hypnotism is that it does not exist.

Because time and again it apparently has been demonstrated, thousands of sincere and intelligent people believe in this imaginary force. Because they found it a likely peg on which to hang mysterious happenings that they could not otherwise explain, a number of medical men and psychologists have taken it seriously and sincerely believe in it.

As a matter of fact, hypnotism is nothing but a high-sounding name for a form of strong suggestion. For example, Professor Wells tells how he hypnotized a college student, making him believe that a half-dollar placed on his forearm was a red-hot iron. Naturally, I believe this report made by such a distinguished scientist, but I refuse to believe that hypnotism was involved. The suggestion seems to me no more remarkable than many others not attributed to hypnotic influence.

I know of a negro who had stolen some grapes and eaten them and who then overheard the owner of the vines say that he had sprinkled Paris green on the grapes. He intended to worry the negro, and he did. The thief became violently ill and suffered great agony. Obviously, there was no hypnotism in this; there was just the power of suggestion working on the imagination.

FEAR, bewilderment, absent-mindedness, and even stupor or temporary indifference to surroundings or pain are states of mind experienced by nearly every human being. While in one of these conditions, an otherwise normal person frequently will behave in a strange or unexpected manner.

Those who believe in hypnotism seem to think that simply because one of these familiar states of mind happens to occur under unusual circumstances, it proves that the condition is the result of a peculiar power called hypnotism.

IF THOSE who hold this belief were to say that there are certain ways in which one person may encourage fear, bewilderment, absent-mindedness, or stupor in another, they would hit the nail on the head.

Suppose I suddenly thrust a loaded revolver against a man's ribs. Governed by fright, he may behave in a number of unusual ways, but he will not be hypnotized. If I make the same experiment with an unloaded gun, he will probably be just as frightened. Should I use a toy gun, many persons would be so terrified as to be incapable of distinguishing between a real revolver and an imitation. There are others in whom the sudden action of the bare hand, without

either pistol or toy, would produce the same degree of fear. Yet there would be no hypnotism about it. It merely would be an illusion created in the mind of one person by the convincing action of another person.

Loss of memory (amnesia) and increased memory (hypermnesia), mentioned by Professor Wells as states that may be induced by hypnotism, are common mental occurrences under normal circumstances.

UNDER the stress of excitement, many persons will forget the most important matters. A name, as familiar to them as their own, will slip their minds. The boy who has his recitation letter-perfect forgets it when he steps onto the platform.

Cases of suddenly increased memory are also frequent. Some long-forgotten incident, name, face, thought, tune, or story will spring into one's mind at the most unexpected moment.

The actions of the hypnotic "operator" simply tend to induce such states of mind. If his "passes" or other antics are disturbing, the "subject" will become excited and naturally be susceptible to forgetfulness. If the "subject" is not disturbed, but is lulled into a contemplative state of mind, he will be apt to remember past events.

In speaking of "passes," Professor Wells states that face-stroking manipulations made by the hypnotist are intended to bring about a relaxed and drowsy state, such as one may experience when in the barber's chair, enjoying the manipulations of the barber. This fits in exactly with my conclusions. The barber is not a hypnotist, yet he is getting the same results. When the hypnotist does produce unusual effects, it is because he takes advantage of a mental condition that the "subject" might have attained in a barber's chair.

Linking automatic writing with hypermnesia, Professor Wells gives an instance of a student who, under "hypnosis," wrote down past events that he had forgotten.

Automatic writing, like sudden flashes of memory, is a common mental reaction. Thousands of people draw queer geometric figures, faces, and diagrams or write apparently meaningless words while waiting for a telephone connection or listening to an uninteresting discussion.

Is that hypnotism? Of course not. It is chiefly absent-mindedness. Hypnotism has been defined as "an extreme form of absent-mindedness." It may also be called an extreme form of fright or bewilderment.

When I was about eighteen years old, I joined a committee from the audience that was invited to come on the stage during an exhibition given by "Professor" Flint, famous "hypnotist." Two of us were standing close beside the performer, and he quickly looked us over.

The professional hypnotist's confederate, when laid with his feet on one chair and his head on another, arches his back and becomes a human cantilever that can support great weight.

The subject's head is forced back until it can be held with one finger. In this position it can't be raised and the trick works.

"WORK with me, boys," he whispered. "Do everything I tell you. See me after the show; I'll fix you up."

We entered into the game and did all the foolish things the professor suggested. Afterward, we went to the stage door and were paid.

The professional hypnotist uses various artifices to make his "demonstrations" appear effective. Troublesome committeemen he classes as "unsuitable subjects," thus disposing of them. Those remaining are persons he can easily deceive, or who will work with him on request, and his own "plants" or "horses." He depends upon these "horses" for his most sensational tests.

Placing his finger upon a person's forehead, the hypnotist says: "Close your eyes. Keep them closed. Look upward without opening your eyes. Now! You cannot open your eyelids! You cannot open them! Try!"

The "subject" makes the attempt and fails. Wonderful! But no hypnotist is necessary. Any one can try it for himself. It is virtually impossible to open the eyelids while the eyes are raised.

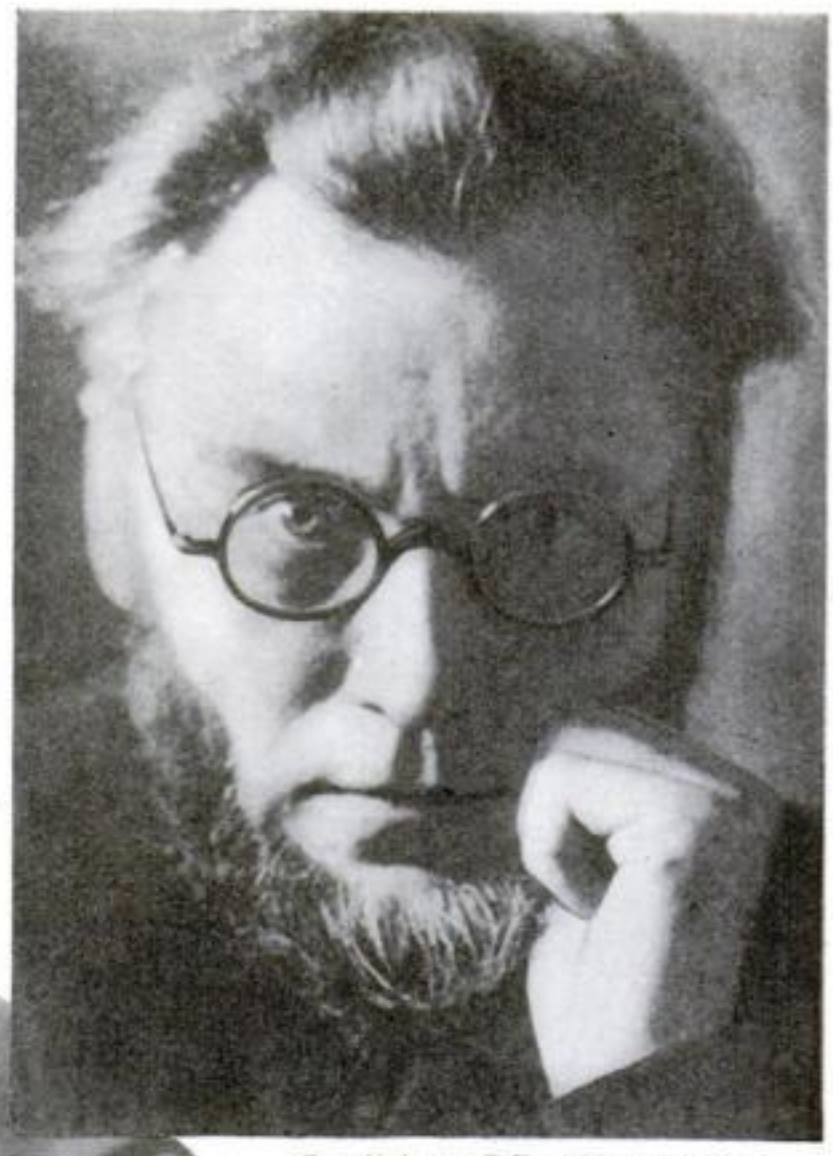
A professional hypnotist can make a normal person stutter. He tells his "subject" that he cannot talk without stuttering. The "subject" denies this. Then the hypnotist gives him words to repeat aloud. The "operator" begins to stutter over the words, and soon the "subject" is doing the same thing.

This is a very convincing test. Yet it is purely a case of clever suggestion. A somewhat nervous person will become confused and in his embarrassment will experience, under suggestion, the uncertainty suffered by the chronic stammerer.

(Continued on page 148)

"Death Masks" to Solve Crimes

Negacoll cast of Vienna murderer's hands. They are very lifelike.



Dr. Alphonse Poller, Viennese anatomist, whose new method of making death masks of the living identifies criminals.

By HYATT E. GIBSON

In making a cast of the top of the head, the negacoll is put on with a syringe. Above, the cast, in which note the distinctness of the hairs.

BLUE-FACED, the neck swollen to twice its normal size, the body of a young man was found some weeks ago in a woods on the outskirts of Vienna, Austria. He had been strangled. The savage imprints of the murderer's fingers were still visible on the throat. There was not a mark of identification on the victim. The police took the body to the morgue.

A hurried telephone call was made. Ten minutes later a tall, stoop-shouldered, bearded man entered the mortuary chamber. Peering through tortoise-shell spectacles, he examined the corpse and silently set to work. From a bag he produced a box containing a substance resembling chopped raw meat. This he heated, allowed to cool, and then with quick, dexterous hands he applied the material, now extremely flexible, to the murdered man's face and neck. The hair he covered with the stuff by means of a broad-mouthed syringe. In half an hour the job was finished, and that same afternoon the victim was buried.

Next morning a bust of the dead man, startlingly accurate in every detail, including the murderer's fingerprints, was delivered at police headquarters. Within a week, the victim's relatives identified the cast, and a few days later the police, with the fingerprints as a clue, captured the criminal.

That was one of the first successful tests of a new method of crime detection and identification devised by Dr. Alphonse Poller, Viennese anatomist. Since then, the police of the Austrian capital have adopted it and discarded the Bertillon fingerprint system. For Dr. Poller's modeling material, which he calls "negacoll," and the composition of which is a secret, can be applied with facility to the living or the dead. The Viennese rogues' gallery now resembles an old-time dime museum, filled with reproductions of the faces, noses, ears, and particularly the hands of all manner of lawbreakers. Already several crooks have been trapped through these "death masks" of the living.

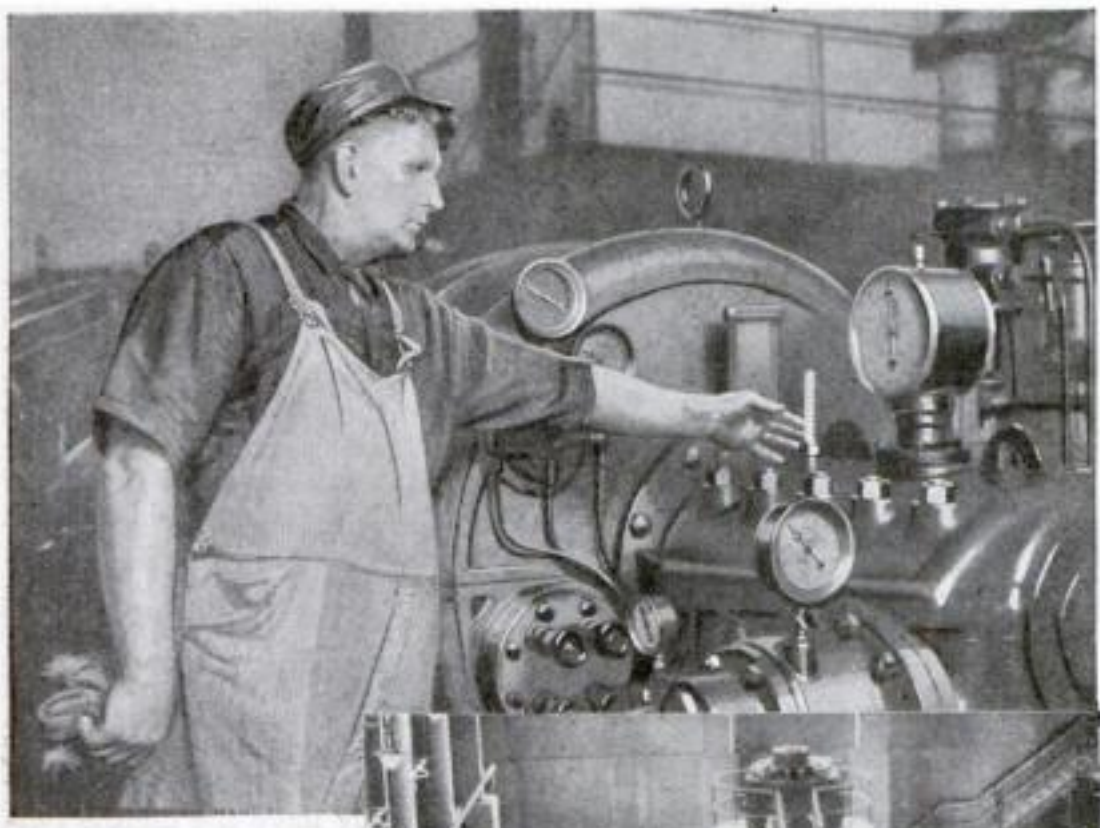
In many ways negacoll is superior to clay and other substances used in making plaster casts. Fashioning a cast of a living person is a lengthy, laborious process involving the danger of suffocating the subject by closing his pores. With negacoll a head may be reproduced inside half an hour. The usual death mask presents only a sketchy likeness; the hair, for example, is never copied successfully, and to duplicate the back of a head is next to impossible. Through its extreme plasticity negacoll produces an almost incredibly exact image of the subject, showing each individual hair on the head and the tiniest line in the face.

In casts of the hands, the whorls on the finger tips are so distinct

(Continued on page 156)

This cast was made of a victim strangled in a forest near Vienna. From it the dead man was identified by relatives several days after his burial. Fingerprints on neck helped find the murderer.

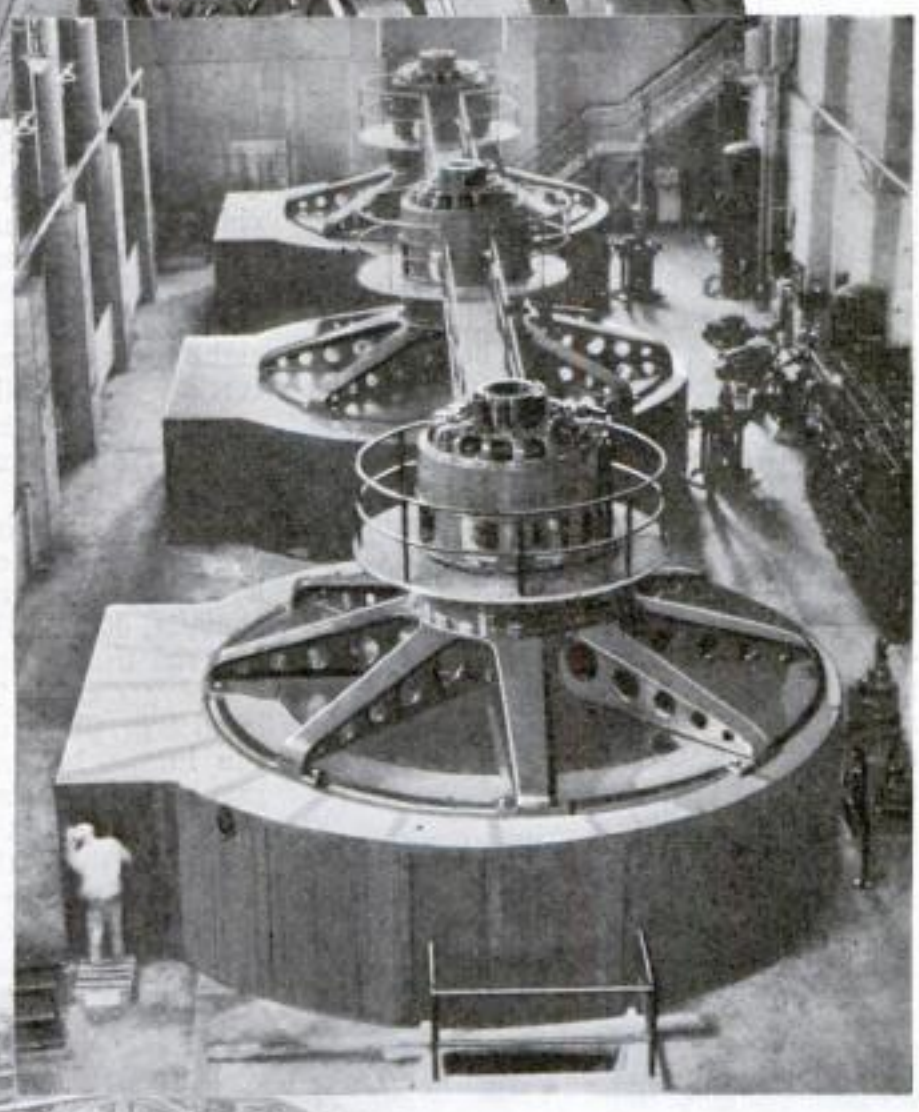
Oil Makes the World Go Round

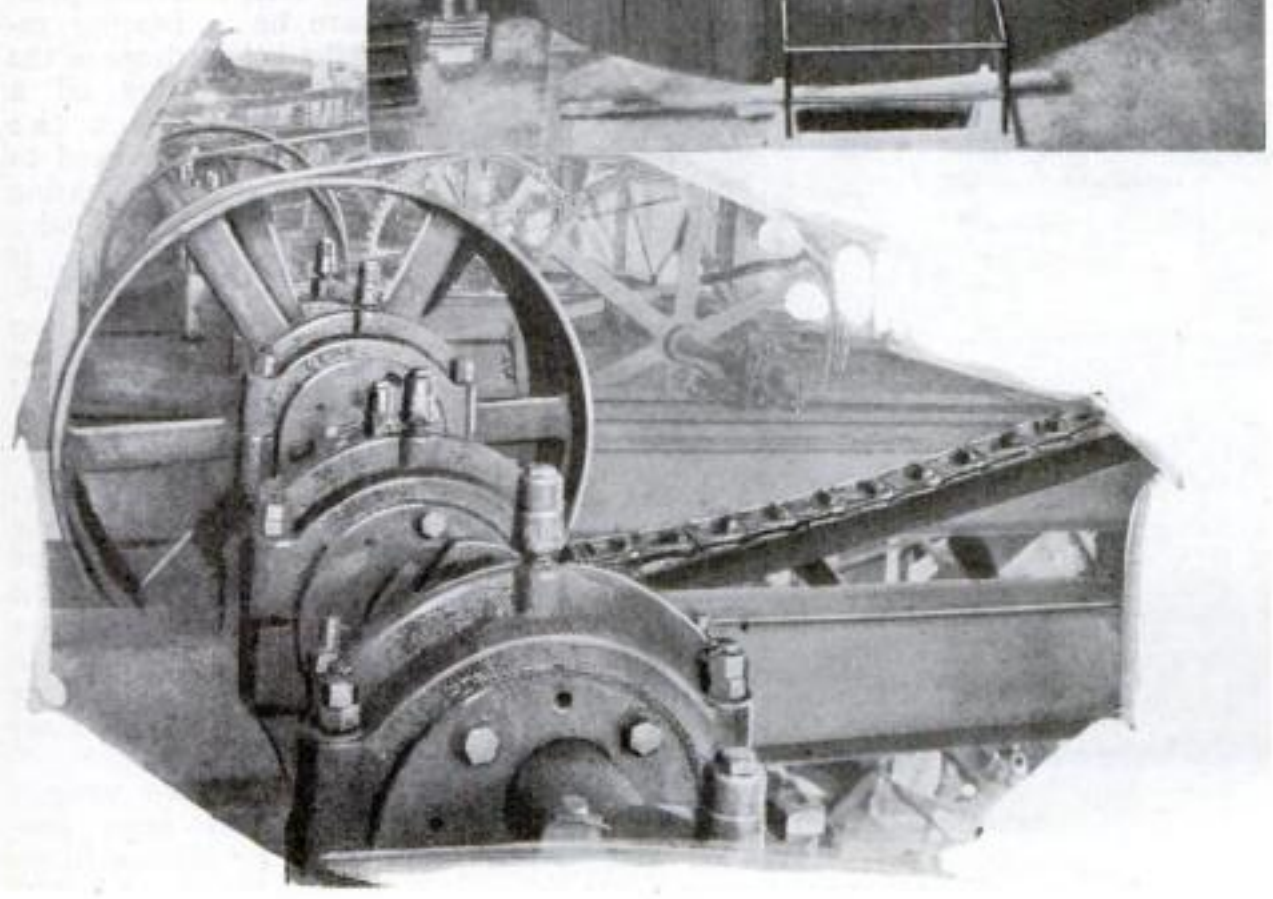


The thermometer, above, tells the engineer if the lubrication is sufficient. If the gage is above a certain limit it is a danger sign and shows the need of immediate increase in oil supply.

At the right: These three giant 12,000-kilowatt generators operate upon single massive bearings at the top. Experts had hard work finding just the correct lubricant to keep them running smoothly.

Below: This heavy duty factory machinery runs slowly, but the job of finding the right grease to use on it was just as important as getting the proper oil for fast moving engines.





Do you know what lubricant does and why it is true that all your comforts and even food depend upon it? This article shows what smooth running wheels mean to our civilization and why if they stop men will starve.

By

GEORGE LEE DOWD, JR.

WHEN Army airmen from an eastern air field join the Caterpillar Club, by leaping from disabled planes with parachutes, they are aided by a strange new use of graphite. To prevent the formation of static electricity from friction, as the folds of silk rub together in opening, graphite is sprinkled in the pack. Besides being an excellent conductor, it forms a lubricant which allows the silk to slide along with a minimum of friction. The theory that caused the adoption of this precautionary measure is that static electricity might hold the silk folds together, preventing the parachute from opening in an emergency.

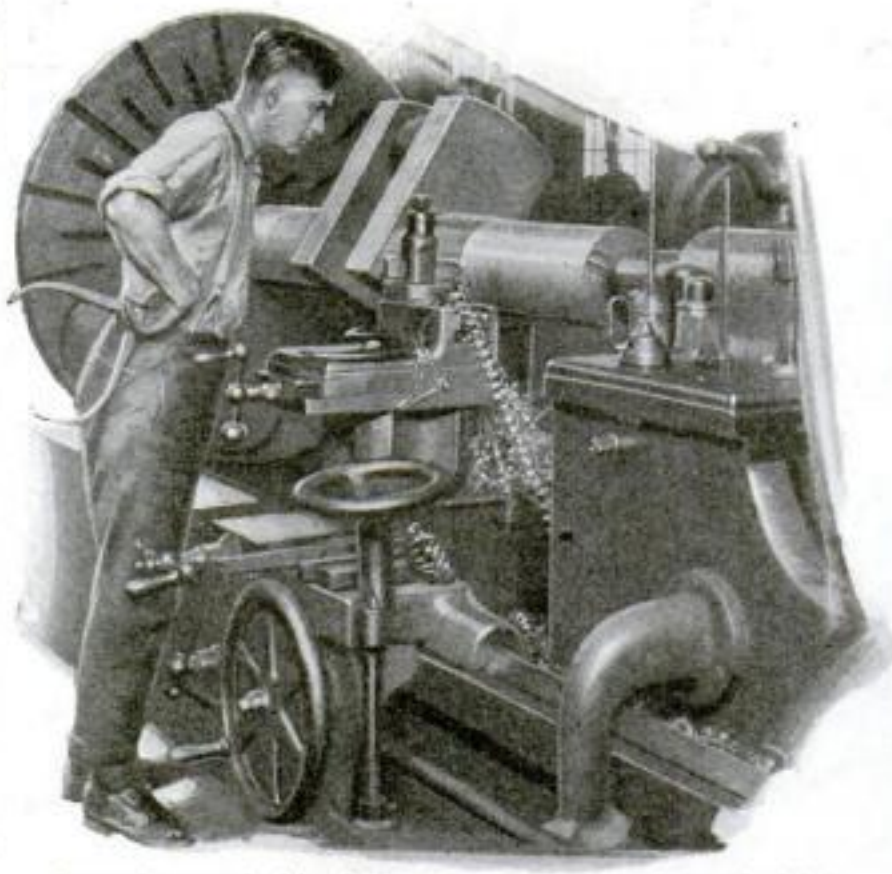
This is only one of many unique new tasks being found for lubricants. Today the world depends upon lubrication for its life almost as truly as the aviator depends upon his parachute. Without proper elimination of friction, the millions of whirling wheels that supply clothing, food, and information would stop, paralyzed. Everything from wrist watches to the giant turbines of city electric plants would cease to function. Transportation would halt, factories would lie idle, mankind would be cut off from sources of food. While the invention of the wheel made the present machine age possible, it was the devising of proper lubricants that has made it practicable.

HOW does a lubricant work? Before we can answer that question, we must learn what friction is. Under a microscope, the smoothest surface is seen to be covered with projections, like a cat's tongue. When two surfaces are pressed together and moved, these projections interlock and resist movement. This resistance is called friction. The amount depends upon the roughness of the surfaces and the force applied. Friction is divided into three kinds. First, solid or dry friction caused by two unlubricated surfaces rubbing together. Second, greasy friction, when partially lubricated surfaces, coated with a thin film of grease, rub together. Third, fluid friction, when the surfaces are completely separated by the lubricant.

Recent investigation has revealed that the oil film, which forces the surfaces

apart, is made up of at least three layers. One layer clings tightly to each of the surfaces and moves with it. One or more layers of free oil are between. Thus it is actually fluids, and not solids, that slide upon each other. That is why oil lubricates things and makes them slippery.

WHAT friction still remains, in such a situation, is "fluid friction"—that is, the reluctance of different layers of oil to slide past each other at different speeds. What this resistance amounts to depends upon the viscosity or "fluidity" of the oil, sometimes measured by the time a sample requires to flow through a hole of given size. Anyone who has stirred thin oil and thick grease and noted the difference in resistance to the motion will understand this. Variations in pressure have little effect upon fluid friction so long as there is an oil film, no matter how thin it may be, between the two surfaces.



In cutting metal with a lathe the point of the tool must be lubricated to keep it cool. Adding sulphur to the oil helps it do this.

In fact, a recent X-ray examination reveals that a thin film of oil, only a few molecules thick, gives the most satisfactory lubrication for an automobile engine. A film thirty-nine billionths of an inch thick is sufficient to reduce to a minimum friction between two glass plates. All the speeding wheels in the world ride upon such a magic film of oil.

WHEN a machine shaft is at rest, it touches the bottom of its bearing and the oil is forced up on each side. But when the shaft begins to turn, it acts as a pump and draws the lubricant under it. Actually it rises into the air, riding on a cushion of oil. One experimenter, F. L. Fairbanks, using super-accurate instruments, discovered that a shaft rises between .002 and .003 of an inch when it begins turning.

Up to the latter half of the last century, practically all lubricants were made from animal fats or vegetable substances. Tallow, sperm oil, castor oil, palm oil, were all used extensively. Whale oil showed too great a tendency to dry out to make a good lubricant, but porpoise oil, taken from the head of this animal, and dolphin oil are still used in fine watches. In some steam engines, where the cylinders reach high temperatures, tallow is still employed as the lubricant, and in huge turbines, castor oil is often used. But these are exceptions. Petroleum lubricants have practically supplanted all other kinds. The reason is that animal and vegetable oils tend to absorb oxygen from the air and so become rancid, thick, and gummy; when they decompose they form acids harmful to metal. Petroleum lubricants, which are of mineral origin, do not have these defects.

SEVENTY-FIVE years ago, machinery was crude, slow-moving. The main shaft of the first gas engine, built in Germany by N. A. Otto, made between 150 and 250 revolutions a minute. At the time, this was declared by engineers to be the maximum that a gas engine would stand. Today, 4,000 revolutions a minute are common in automobile motors, and racing cars make as high as 6,000 revolutions a minute.

As the speed of moving parts has increased, lubrication has had to become more effective. Medium priced cars are now designed to make more than seventy miles an hour, and practically every automobile on the market can easily attain a mile-a-minute rate. Average speed on American highways has increased rapidly in recent years. The result is hotter engines and hotter oil and, consequently, greater difficulty in maintaining proper lubrication. The average crank case oil temperature at thirty miles an hour is 130 degrees Fahrenheit. At sixty miles an hour, it is 190 degrees. Science is seeking improved lubricants for the new cars.

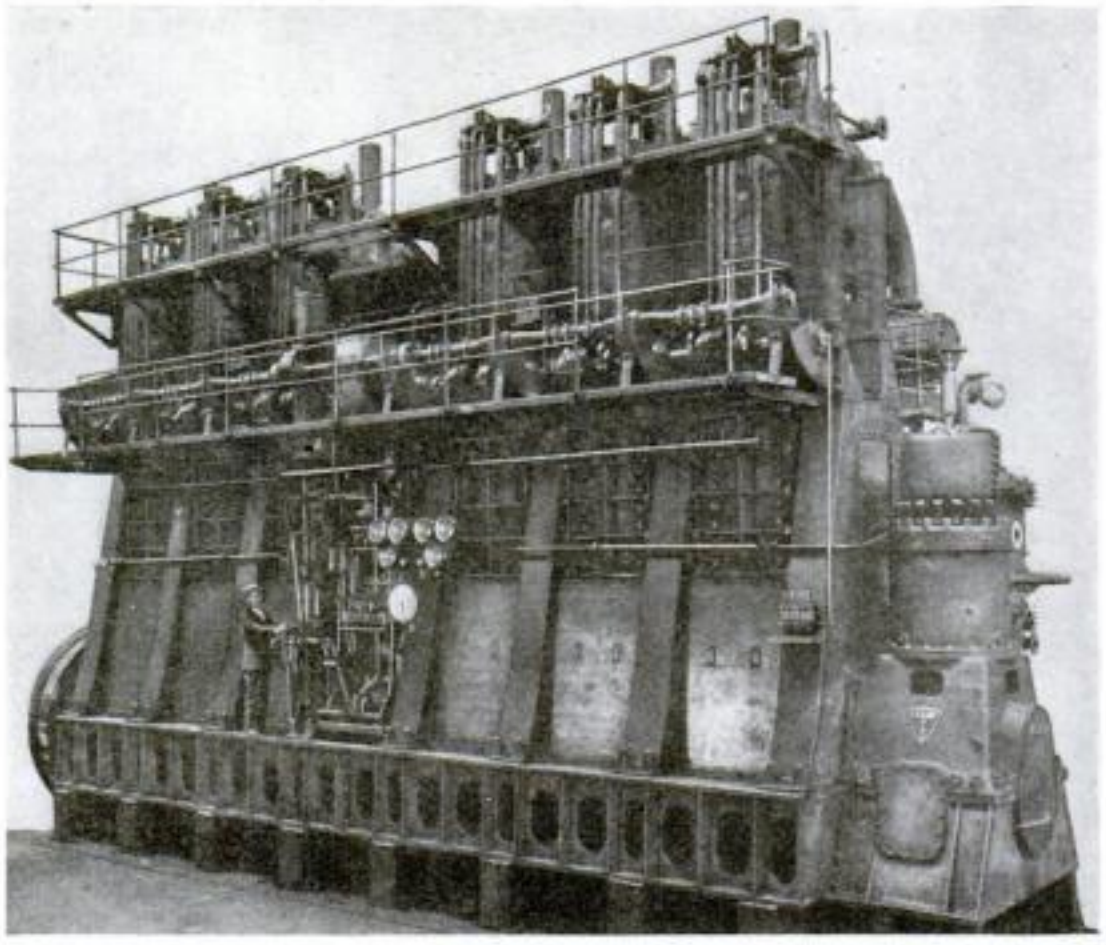
ONE company, after exhaustive laboratory experiments, leased the Atlantic City Speedway and sent five cars spinning around the wooden bowl day after day at top speed, eight hours a day, to make tests of their new lubricant under actual high speed conditions. It is now known that there is no sure laboratory yardstick for measuring the suitability of a lubricant for actual service. There is some mysterious element in a good lubricant that eludes pigeonholing.

Another mystery is found in sulphur cutting oils. They have the double purpose of lubricating and keeping cool the cutting edge of lathe tools and other machine tools. It has been found that the addition of sulphur to the oil results in an amazing improvement for certain kinds of work. Where ordinary oil requires eight turns of a machine to cut steel to a certain depth, oil treated with sulphur produces the same result with one turn. Why? Nobody knows exactly.

AGAIN, there is the seeming miracle of "deflocculated" graphite, produced by the distinguished American electrochemist, Edward G. Acheson, who discovered the abrasive material known as Carborundum. The name "deflocculated" graphite means, literally, "with the lumps broken up;" actually it is graphite that has been reduced to particles so minute that they are nearly as small as single molecules. In one test, a certain pressure on a bearing required eight drops of the best lubricating oil a minute. When the amount was reduced to seven drops, the bearing "froze." Yet, under identical conditions, it was sufficiently lubricated with *one* drop every *two* minutes of the *same* lubricating oil when it contained a minute quantity of the deflocculated graphite. This addition made the oil sixteen times more effective. Whether this "miracle oil" will have handicaps that will make it impractical for wide use remains to be ascertained.

Another new weapon which has been produced by science in its

(Continued on page 154)



Oil so heavy that it would stop a small machine must be used in these Diesel engines that drive liners. The shaft they turn is on bearings of lignum-vitae, which is self-lubricating.

NEW IDEAS AND INVENTIONS

On this and succeeding pages are described the latest achievements of inventors and novel applications of scientific progress

NEW FIRE ESCAPE DEVICE IS SIZE OF ALARM CLOCK

FIRE protection may now be carried with one in a compact and convenient form. A small, portable "spider" life line, housed in a metal drum about the size of an alarm clock and with a body belt attached, recently was demonstrated successfully in London, England. The novel fire escape may be attached to the casement of an upper story window. In making a quick escape, a person need only fasten the belt about his waist and lower himself by feeding out the steel cable line from the drum as a spider spins his thread. Safe descent is said to be assured by an automatic control on the drum which "feeds" the line out at a definite rate. The descent can be stopped and started at will by the person being lowered.

England's portable fire escape is lowering this girl to the street 90 feet below. *Top photograph:* Note the lever that starts and stops descent.

GERMAN FOXES BROADCAST THEIR OWN "SOS"

VALUABLE silver foxes raised on a farm in Eisenberg, Germany, report their safety or peril to their keeper, via the radio "mike."

Success in raising these creatures in captivity is greatly hampered by the attacks of dogs and wild cats, and by the temperamental disposition of the foxes, who in panic frequently kill themselves and each other. On this fox farm, which is near the famous German university of Jena, a microphone, like that used in radio broadcasting, has been installed in the fox pens and connected with an amplifier and loudspeaker in the keeper's quarters. When all is well only the normal night noises of the pack come from the loudspeaker. But if a marauding animal tries to break into the pens, or if a fight starts among the foxes, the noise, magnified by the radio apparatus, rouses the keeper, who can go immediately to the rescue.

DROPPED FLARE LIGHTS AIRPORT FOR PILOTS

PILOTS arriving at an airport after dark can turn on its lights from the air in a new system developed in Spain.

When the pilot is over a triangle of colored lights on the ground, he drops a lighted flare. Within the triangle, a concrete pillar holds a sensitive "electric eye" or photo-electric cell. The glow of a flare dropped within 200 feet of the pillar actuates the cell and operates an electric relay, lighting the boundary and obstruction lights of the airdrome. A similar American device turns on the lights when a siren on the approaching plane is sounded (P.S.M., May '29, p. 72).

SUPERCHARGERS CUT SIZE OF DIESEL ENGINES

SUPERCHARGERS, those devices which feed compressed air to aviation motors, enabling planes to fly to extremely high altitudes, may now improve, by fifty percent or more, the power of Diesel motors used on sea, on land, or in the air. This is the claim of A. Rateau, French inventor of a pioneer type of gasoline-motor supercharger already internationally used in aviation.

Successful tests of what are said to be the first superchargers of their kind designed for oil, instead of gasoline, motors have been made on a ship at Belfast, Ireland, previous tests having been made in a Copenhagen factory. The first Diesel or oil-burning motors equipped with superchargers were eight-cylinder, four-cycle marine engines used in pairs for passenger and cargo ships of 15,000 tons. They were designed for a maximum power of 3,300 horsepower apiece, but each developed about 5,000 horsepower with the superchargers, a gain of one half. These superchargers were turbine-blowers operated by the pressure of exhaust gas from the Diesel motors.

Rateau declares that supercharging reduces the size and weight of a Diesel motor for a given power—an important consideration in aviation, where oil motors already have been tried experimentally. The higher-pressure superchargers now being developed may effect even further improvements. Rateau has designed high-pressure types for aviation gasoline motors, and in this field now introduces a remarkable new type to multiply by sixteen the atmospheric pressure at a height of 59,000 feet—should airplanes be able to fly that high.

WAR GAS AIDS FIGHT ON WORMS IN CHURCH

CHEMISTRY has been called to help antiquarians save the woodwork in a fifteenth-century church in Linz, Austria.

Like much of the older European furniture, the ancient altar and pulpit are worm-riddled. Scores of methods to save them from further ravages have been tried in vain.

As a last resort, the custodians have tried poison gas, developed during the war. Under the direction of experts in chemical warfare, the old church was sealed, filled with the poison gas, and left alone for a week. The seals were then

broken, the edifice opened and aired, and worship resumed.

Whether the worms at work in the precious woodwork have perished or not cannot be determined for some time. In any event the old church probably will have to be "gassed" again before long, to kill any new arrivals hatched from larvae unaffected by the fumes. The results of this new experiment in disinfecting will be awaited with interest by antiquarians who are eager to preserve architectural beauty on the continent.

OVERNIGHT PHONOGRAPH FITS IN TRAVELING BAG

CLOTHES, music, and a happy week-end may all be packed together in a combination phonograph and traveling bag lately put on the market. The phonograph is built into the lower portion of the bag as solidly as a safe in the wall of a bank. It has a spring motor turning a disk that accommodates the regulation ten-inch phonograph record.

Sturdy compartments make up the traveling kit section, with a clothing tray fitting over the phonograph. All one needs to do when music is desired is to remove the tray, lift the tone arm of the phonograph, and put on a record.

25,000 SLICES TO AN INCH

THE most modern machines for making thin slices can pare them off only one micron, about 4/100,000ths of an inch, thick. These machines, known as "microtomes," are used in biological laboratories for cutting fragments of specimens for microscopic examination. Some of these are automatic devices which will prepare from one specimen a series of sections for comparison.

POISON TESTED ON INSECTS TO SHOW FATAL DOSE

How much poison it takes to kill an insect is the question to which Dr. F. L. Campbell, United States Department of Agriculture entomologist, hopes "poison sandwiches" will give an answer. These, made of two leaves with poison between them, are fed to the insects in the laboratory. The object of the investigation is to devise methods of exterminating insect pests without danger to beneficial insects.

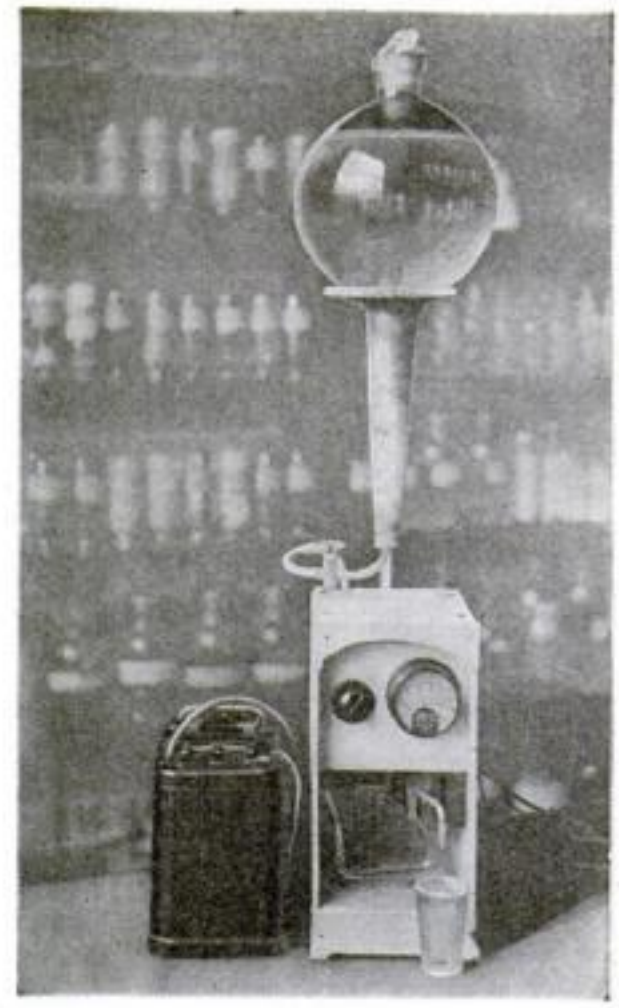
The "sandwiches" are used because an exact method for measuring the quantity of poison on a circular bit of leaf has been developed. An insect is allowed to eat the leaf until observers in the laboratory believe the dose of poison fatal. Then the amount of remaining leaf, and hence of poison, is carefully measured, and the insect allowed forty-eight hours in which to die or recover.

The first experiments were made with silkworms feeding on mulberry leaves. Dr. Campbell intends to try out his plan on many species of insects.

TINY TRANSMITTER, SENT ALOFT, TELLS OF WINDS

A TYPE of pilot balloon recently developed by the United States Signal Corps is used to learn the speed and direction of winds when it is impossible to follow the movements of a balloon by means of a theodolite. A miniature radio transmitter, sending automatic signals and weighing less than a pound, is sent aloft attached to three hydrogen-filled balloons, which are inflated until they will rise at a speed of 200 yards a minute. Hence the height of the apparatus at any moment is known from the time elapsed since its release. At definite stations the signal direction is determined each minute by means of direction-finding receivers. From these data, reported to a central point, the speed and direction of the air in which the balloons are drifting is worked out.

United States Signal Corps engineers invented this tiny broadcaster which, carried aloft by balloons, radios reports of high altitude winds.



TURN OF SWITCH MAKES POWERFUL ANTISEPTIC

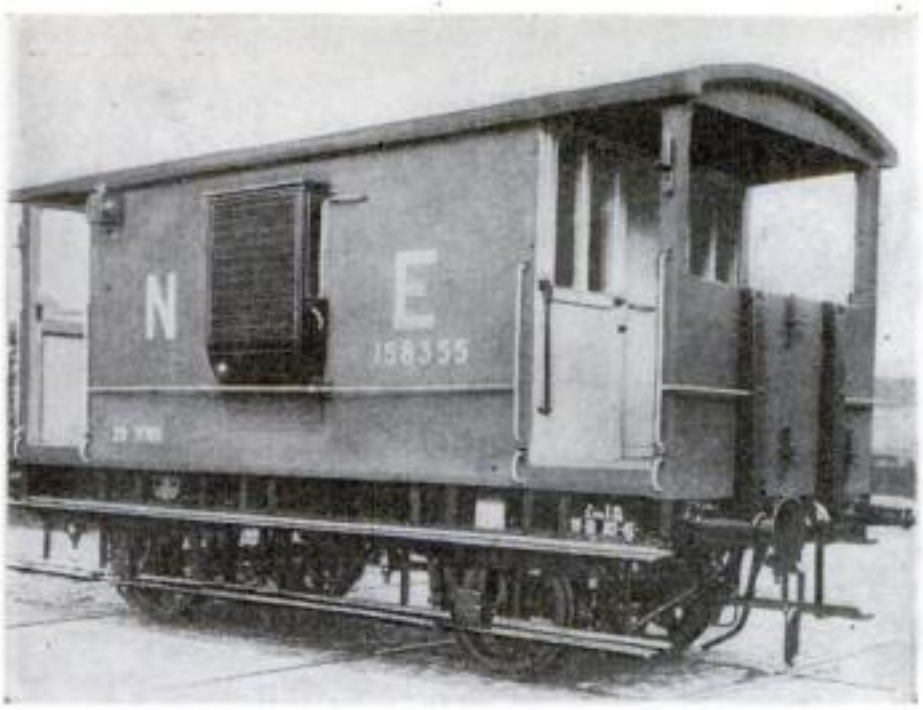
DAKIN'S solution, the antiseptic adopted by war hospitals and in use in every operating room, may now be made by the mere turn of a switch. An ordinary lighting current creates the antiseptic from a solution of common salt. The apparatus necessary comprises a glass bulb container for the salt and an electrolytic cell which was originated in the chemical engineering laboratories at Iowa State College. What it does is to rearrange the atoms of salt in solution so that sodium hypochlorite, the basis of Dakin's solution, is formed. The value of this solution for surgeons lies in its power to split off little particles of chlorine, called "nascent" chlorine, when it comes in contact with animal tissue. In so doing it sterilizes a wound, stifling any germs that may be lodged there and safeguarding the patient.

Carbon electrodes are used in the special cell. The salt solution flows out of the bottom of the glass bulb between the electrodes, where the chemical transformation occurs. The final solution passes out through a glass tube on the side of the cell. Electricity for the process is supplied by an alternating current light line through a battery charger and is controlled by a rheostat similar to those used on radio sets.

FOG IN FRONT OF AUTO CLEARED BY EXHAUST

HOT air from the exhaust is caught by a new device and sprayed in front of the car to reduce the danger of driving in fog, according to reports from London. This hot spray clears the fog to a height of about ten feet in front of the car, it is said.

So rapidly is the clearing done that a speed of fifteen miles an hour through the densest fog is claimed to be possible.



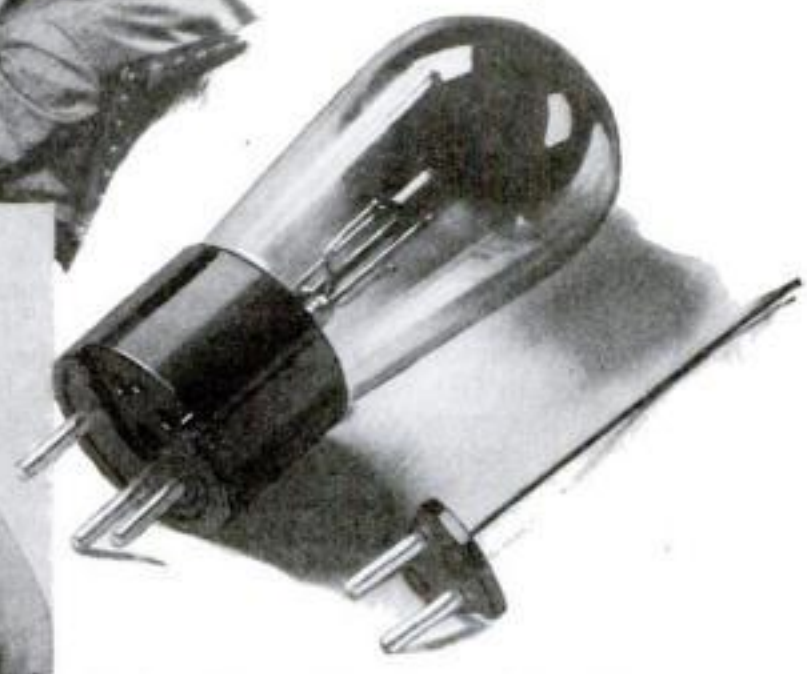
British Railway Car Made of Concrete. For the first time in railroad history, concrete is used for cars. The caboose, or "brake wagon," above, was made for the London and Northeastern Railway. Its sides, floor, and roof are of concrete reënforced with steel, on a standard steel underframe. The heavy concrete is used in an effort to eliminate ballast.

Emergency Dams Guard Hollywood. A small army of workmen labored like beavers with tractors, steam shovels, hammers, and saws to build this series of timber check dams made necessary by a recent brush fire which swept over a large part of Griffith Park in Los Angeles, Calif., leaving the hillsides barren of protective covering. The solidly built chain of dams will hold back possible flood waters.

Portable Talkies Arrive

Now business and education may have their own sound films. The equipment has three small units—the projector, the pick-up and amplifier unit, and a dynamic speaker, each contained in a separate case and hung on springs to withstand the shocks of hard usage in transportation. Sixteen-inch phonograph records are used. Coupled together on a flexible shaft, the sixteen-millimeter film and phonograph are perfectly synchronized. It is designed to run on alternating current, though a portable converter for direct current may be obtained. If it is desired, silent films as well as sound films can be projected by the machine. In the photograph above a travelogue is being exhibited.

Mrs. Clara Quinn, of Cleveland, Ohio.



Radio Tube with Renewable Filament

Mrs. Quinn, a radio research worker, has developed this novel A. C. heater type tube. The electron-producing cathode is in the form of a tiny cylinder closed at one end with the glass bulb sealed around the open end. The heating filament thus can be pulled out and a new one inserted without destroying the vacuum in the tube. Radio fans would have welcomed such a tube in the days when filaments burned out all too frequently. Filaments in modern tubes, however, outlast the electron-producing life of the cathode.

NEW IDEAS AND INVENTIONS

TRACTOR-DRAWN MACHINE PLANTS SUGAR CANE

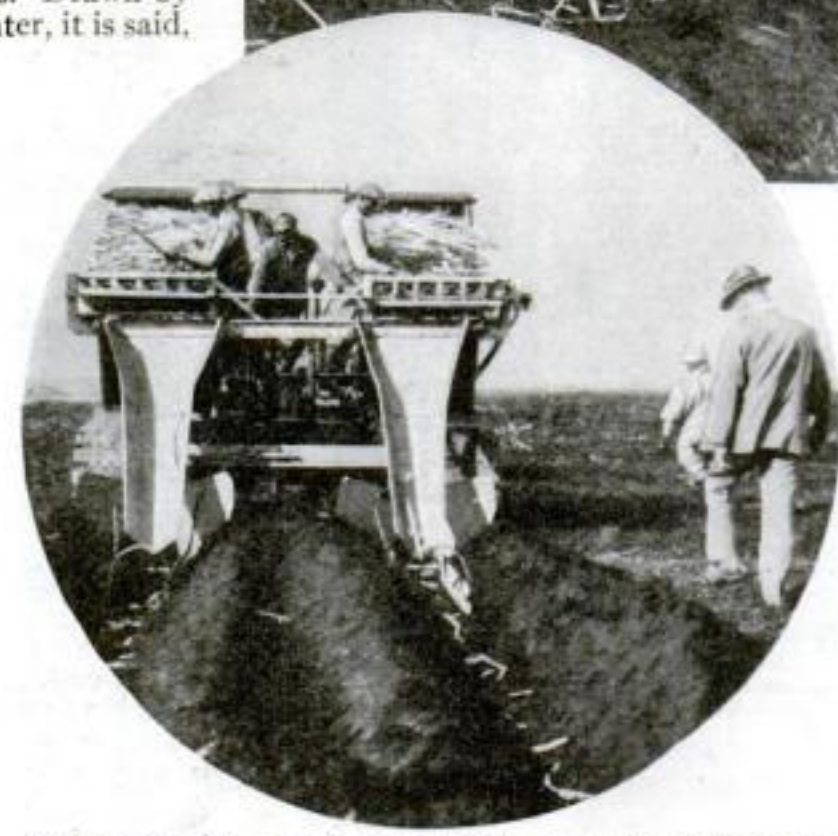
WITH the perfection of a machine for planting sugar cane, science has won another victory in the effort to conquer the Florida Everglades.

The cane planter is the invention of N. C. Storey, for five years superintendent of mechanical maintenance of the Panama Canal and now mechanical engineer for The Dahlberg Sugar Cane Industries, which is converting approximately 175,000 acres of Everglades swamp land into an up-to-date sugar plantation.

Running on caterpillar treads, the machine simultaneously plows the swamp and sets the cane seed stalks. Drawn by a caterpillar tractor, the planter, it is said, sets twenty acres of cane in a day, the normal work of twenty men. It is equipped with two bins, which carry enough cane to plant two acres. An elevator system, driven by power from the tractor, lifts the cane from the bins to endless conveyors. These carry it to two chutes down which it slides into the furrows. One man watches the flow of cane stalks on each conveyor.

The tractors draw the cane planters at speeds ranging as high as fifteen miles an hour. The plows, which turn the furrows, are directly in front of the cane chutes and can be raised or lowered, while the machine is in motion, by power from the tractor.

Twenty of these planters are now at work in the Everglades. Their operation, it is claimed, is so simple that unskilled labor can be taught in a few minutes to handle them.



This machine plows two furrows and plants two rows of sugar cane at the same time. Twenty of these, drawn by tractors, are doing the work of 400 men in the Everglades, now being reclaimed.

The old way. Many men are needed to dig and fill when the sugar cane is set out by hand.

PSYCHOLOGY MAY MAKE AUTOS RIDE EASIER

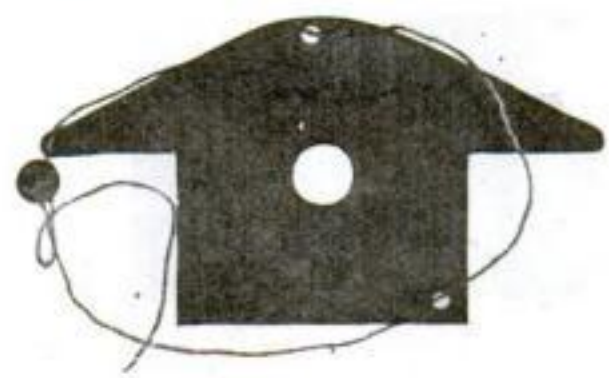
AUTOMOBILE comfort is now being analyzed by testing motorists after they have finished a 150 to 400 mile run. Dr. Fred A. Moss, of George Washington University, psychologist in charge of these tests, believes that the comfort of a car should be judged by the amount of fatigue it occasions its occupants. This fatigue, he thinks, is nervous rather than muscular. As an indication of this a motorist who, after a long ride, tries to do mental gymnastics such as arithmetic finds that he is below par. Other indications of nervous exhaustion are headache, sleepiness, stiffness, and dizziness.

Heretofore manufacturers have spent millions in search of devices for insuring smooth driving to automobiles, most of which have proved unsatisfactory, Dr. Moss said, while recently addressing the Society of Automotive Engineers in Detroit. If comfort were to be measured by psychological methods of the type described, efficient "comfort-giving" devices would be more quickly found, Dr. Moss believes.

STEEL "HOBBLE" SETS LIMIT TO NEW CAR'S SPEED

IN ORDER to insure the engines of new cars against fast driving while en route via highway from factory to near-by dealers, a carburetor "hobble" or controlling device has been devised by a large automobile concern. This "orifice governor" is a thin steel plate placed between the carburetor and the intake manifold, having a small opening that permits only a twenty-five-mile-per-hour gas mixture supply to be sucked into the cylinders of the motor.

Any tampering with the control would be indicated by a break in a steel wire seal which is similar to those in general use by railroads to tell of unauthorized opening of freight car doors.



Speeding is prevented by this sheet steel "hobble," placed between the carburetor and the intake manifold when new car is driven.

PREDICTS NEW ORGANS OF THOUGHT IN MAN

THE world awaits the superman. And now science has predicted him. Dr. Constantin von Economo, of Vienna, has recently prophesied that man's mind will not only improve, but will develop new organs of thought. Addressing a congress of world famous psychiatrists, or mental physicians, in New York City, he said that there are constant improvements in man's mental capacity, and that the limit of development has not been reached. Dr. von Economo bases his prediction on studies of the cell structure of the brain carried on since 1917. He asserts that there are 107 regions in the brain, to some of which he has been able to ascribe special functions. Up to 1913 scientists had described only twenty of such areas. If this theory is sound, the age is approaching when men will comprehend Einstein as readily as they now understand simple arithmetic.

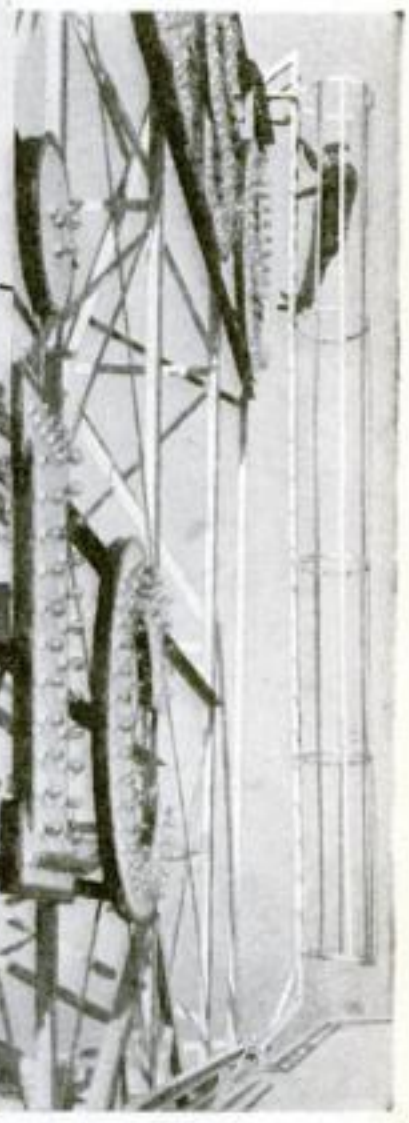
"RATTLE METER" MAKES CHEAP CARS QUIET

TAKING the rattles out of small cars is made easy, it is said, by a new French invention, a "rattle meter," which detects foreign noises in a vibrating motor, transmission case, or chassis in the automobile factory.

Developed for the automobile firm Citroen, which makes a large part of France's small cars, the novel device consists of a microphone, a radio amplifier, and an electric meter. The microphone is placed near the part of the car under test, and the electric meter's reading gives the exact loudness of the rattle, based on an arbitrary scale, for comparison with others. Sources of objectionable rattles can then be located and removed. Hitherto the only way to check up on a car's rattles was to give it a thorough road test. For economic reasons this practice is possible only with high-priced cars. The new rattle meter promises the small-car buyer an automobile as nearly noise-proof as more expensive models.

A Ghostlike Orchestra. An American radio engineer in Vienna has arranged an orchestra that plays without musicians. The mystery lies in the fact that each instrument, shown above, is a loudspeaker, connected with a phonograph offstage, seen below. Cables carry the music to the instruments, whence it issues as though they were being played.

Chute-the-Chutes on Rollers. Children are given a chance at a novel experience on this coaster which has ball-bearing rollers upon which to slide instead of a smooth surface. The rollers are so close together there is no bumping, and while the trip is fast, the inventor claims that there is not much chance of injury.



Not a Bolt in This Big Sign. Cleveland has this electric sign, above, which is one hundred feet wide and hasn't a bolt or a nut in it. It is entirely arc welded, the first of its kind. Its structural strength is such as to withstand the Lake Erie gales. At right is the cage ladder used in changing the lamps in the sign. It is said to make aerial electric work safer.

Wooden Bathing Suits. These two girls are wearing bathing suits of wood. They are the latest novelty for use on the bathing beaches. Fashioned of thin spruce, they are said to be practical as costumes and also are sufficiently buoyant to encourage a timid swimmer to take a plunge. So far, none of them has warped or cracked.

NEW IDEAS AND INVENTIONS

NEW TYPE MICROSCOPE HAS NOVEL FEATURES

UNUSUALLY powerful and versatile, a new microscope placed on the market for research workers can be adjusted by a quick change of its lenses to give any magnification from fifty to 2,250 diameters. Such great magnification is extraordinary in a portable instrument. The most powerful microscope in the world, a bulky piece of apparatus in the Bell Telephone Laboratories, New York City, magnifies objects a little more than 6,000 diameters.

In the new instrument the stage, on which objects are placed for examination, is on the side nearest the user, giving easy access to slides of specimens. Twin eyepieces avoid eyestrain or squinting by making it possible to use both eyes at once. These slant toward the operator so that he may sit comfortably relaxed. Microscopic photographs may be made by laying the instrument on its back in a horizontal position, the design of the frame insuring steadiness.

A new type microscope with magnification up to 2,250 diameters has the stage next to the operator and tilted eyepieces.

MAN-MADE PLANT YIELDS STOCK FOOD AND PAPER

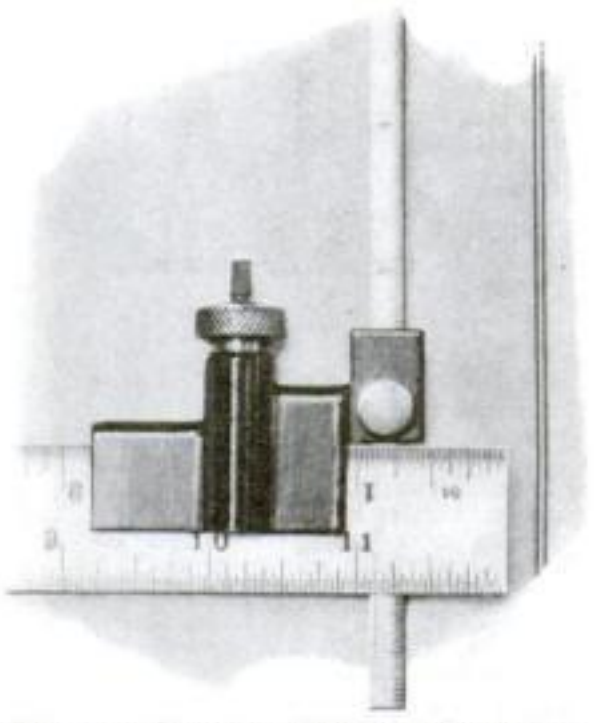
A NEW plant, "made" in England, after many years experiment by Leonard Browning, yields a valuable raw material which may supplant jute, hemp, and sisal fibers. Experts consider its wood excellent for fine grade paper, and its seed highly nutritive as a food for cattle. The plant is known as brotex.

It can be readily cultivated, either by direct sowing or by transplanting from nurseries, and its growth is very rapid. The yield is sixty tons to the acre, producing slightly more than two tons of the air-dried, commercial fiber. This is valued at $160 a ton.

GAGE ON SQUARE SHOWS CASTING RECESS DEPTH

WITH a new depth gage attachment, the combination square of the garage man or machinist takes on new usefulness. The attachment aids in measuring instantly the depth of a recess in a casting of any sort, where its width would make the measurement difficult with any other type of instrument. While the square is held on the upper surface of the casting, the gage plumbs the bottom of the recess. It can also be used to measure the depth of holes, in order to determine the proper length of a bolt or plunger.

Clamped to the blade of the T-square, the attachment uses a set of measuring blades graduated in various ways. A thin rod is also provided for measuring small holes.



This gage, with graduated blades, is clamped to a square and used to measure casting recesses.

WATER BLISTER FLUID CURES DRUG ADDICTS

FROM Egypt, rapidly becoming the medical center of the Orient, comes a report of the accidental discovery that injections of fluid from a water blister, such as is raised by mustard plaster, may be used to cure the drug habit.

Word of this strange cure reached the American Medical Association from the European Hospital at Alexandria, where Dr. Modinos, chief attending physician, had been injecting blister fluid into the body of an Arab afflicted with rheumatism, a common treatment for this disease. But the Arab also happened to be a cocaine addict. To the physician's astonishment, the Arab completely lost his desire for cocaine.

Acting on a hunch, Dr. Modinos tried the blister fluid on a morphine addict. Again the striking result, with a complete cure after two injections. With such unique evidence to support them, the officials of the European Hospital intend to test the treatment on all drug addicts that enter their halls.

ARTIFICIAL SNOWFLAKES MADE WITH LIQUID AIR

ARTIFICIAL snowflakes have been produced for the first time in Los Angeles, Calif., a city that almost never sees natural snow. Professor John Mead Adams, of the University of California, after ten years of research has perfected an apparatus for creating snow crystals from liquid air. Immensely colder than the water vapor from which flakes are formed in the sky, liquid air exists at temperatures colder than 190 degrees below zero. In the Adams process, liquid air evaporates to form a stream of cold dry gas that meets in a cold chamber a counter stream of cold moist air only a degree or two above the freezing point of water. Instantly the super-cold gas turns the moist ordinary air into thousands of snow crystals. The flakes so produced, however, are so small that they must be looked at under a microscope. Some of them grow larger by devouring, like cannibals, their smaller fellows.

All previous attempts to make snow by freezing fog or by cooling water sprays have failed. The flakes, all of which are six-sided, are formed according to the laws of water crystallization; and their growth is believed to be due to condensation on an initial crystal nucleus. The artificial flakes may be built up into numerous and varied patterns, ranging all the way from cuff buttons to the intricate designs of lace.

DOCTORS ADVISE WOMEN TO KEEP SHORT DRESSES

PHYSICIANS deplore the long skirt "relapse" of women. They would stop, if they could, the change of fashion which seems to be bringing back the hampering dresses. Health, they claim, is outraged by the long, sweeping skirt, which stifles activity. If there is a return to the "wasp waist," demanding corsets and form-fitted dresses, it will mean, they say, a return of displaced organs. Greater health and endurance have come to women as the result of unrestricted physical activity.

Dr. W. G. Morgan, president-elect of the American Medical Association, emphatically declares: "Since the more sane type of clothing worn by women at the present time, there has been a striking decrease in physical defects. Lung capacity has been increased and lung activity become more nearly normal in the average young woman. There has been a marked improvement in circulation with a corresponding improvement in the color and texture of the skin, with a lessening of the necessity of the use of rouge and powder. Let women guard the greater freedom of mind and spirit which has been given to them by their lately acquired physical freedom."

Radio Squeal Is Music

Noises from oscillating radio tubes once more are turned into music, this time in an electric organ devised by R. C. Hitchcock, above, of the Westinghouse research staff. The instrument is played by pressing the keys of a three-octave pianolike keyboard. The volume is controlled by operating a foot pedal. The organ is particularly adapted to radio broadcasting, as the impulses produced are electrical.

No Ribs, but Rain Proof. This folding umbrella, made of waterproof material, fits the pocket or can be carried under the arm, ready for a sudden downpour. Folds on the inside serve as handles.

Air Pads These Boxing Gloves. Pneumatic boxing gloves are being used in place of those padded with hair by Joseph Lapidus, left, director of the Harry E. Burroughs Newsboy Foundation Gymnasium, Boston. They are inflated with a bicycle pump and it is claimed that, while the punch remains, it "spreads" on landing, preventing cutting of the skin.

Tail Lamps for Walkers

In Germany pedestrians are now wearing these safety belts, which have a red reflector attached to the back. A car's headlight, it is said, will light up these reflectors from seventy yards away, thus reducing the danger of accidents on the highways at night. Even if the driver mistakes the pedestrian for a motor cycle or automobile truck, the walker stands an even chance.

Like Riding a Horse. This galloping tricycle is driven by weight of the rider. With his feet braced against the pedals, he raises and lowers himself as in horseback riding. Resultant up and down movement of the seat turns a sprocket wheel.

NEW IDEAS AND INVENTIONS

CARDS OF ALUMINUM LOOK LIKE PAPER

HERE are the new playing cards of aluminum, recently described in POPULAR SCIENCE MONTHLY (Mar. '30, p. 66). They look exactly like ordinary cards, can be handled just as easily, and will not bend or tear. Also they can be washed if they become sticky or soiled after much use.

The cards' weight makes them difficult to blow away, so they are particularly suitable for the summer cottage or for camping or boating trips.

PORTABLE RADIO SOUNDS HIGH VOLTAGE WARNING

LESS easily ignored than a "Danger—High Voltage" sign, a new device, developed in France for electrical workers, howls a danger signal when a line carrying high-voltage alternating current is approached. The compact apparatus, readily portable to be carried on the person, resembles a miniature radio set, loudspeaker and all.

Its principle of operation is the same as causes interference in a home radio receiver from a near-by electric power line. The electric field or influence around a high-voltage carrier actuates a small radio circuit with a vacuum tube and batteries inside the device. It sounds a warning through a small but exceedingly sensitive loudspeaker when a push button contact is made. It may be used to warn of proximity to transmission lines carrying electricity at from 1,000 to 100,000 volts.

GROOVED SCREW DRIVER WILL NOT SKID

THE harder a new "nonskid" screw driver is twisted, it is claimed, the tighter it grips the slot of the screw. Its secret lies in a series of V-shaped ribs cut in the tip of the blade. This feature, the manufacturers say, makes it possible to turn even battered and rusty screws. Slipping when driving greasy or oily screws is also eliminated.

Damage to the screw slots or to the finish of woodwork by a slipping screw driver is thus avoided, it is claimed.

NONFRAGILE COPPER IS SOUGHT AS CONDUCTOR

INVENTORS, seeking fortunes in their search for a process of hardening copper, would better turn their energy to other problems. One of these is to find a way to take the fragility out of copper wire and still leave it a good conductor of electric current, declares W. H. Bassett, who is technical supervisor of a Waterbury, Conn., brass company.

Copper is fragile because of minute quantities of copper oxide in the metal, he says. One of the reasons for alloying copper with other metals, such as zinc, is to remove this oxide. This metal or phosphorus is used to treat practically all the copper made into commercial tubing. But such treatment increases the electrical resistance of the wire and makes it less useful as a conductor.

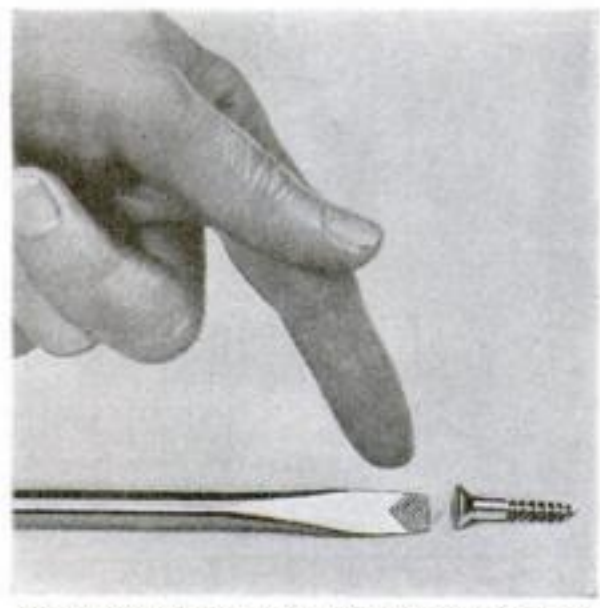
Copper alloys of great usefulness have been discovered recently, according to Bassett. Because of its resistance to corrosion, ambrac, one of these new copper-nickel alloys, is employed in making the condenser tubes used in steam power plants. Alloys of copper with silicon can be welded as easily as steel and, incidentally, yield a copper that has been hardened cheaply and effectively.

One superstition that has persisted for years is that the art of hardening copper is a lost one. This is not true (P.S.M., Dec. '27, p. 52); in fact, modern hardening methods are more effective than those of the ancients. A one-inch bar of good commercial copper, without annealing, can be drawn to a wire only two thousandths of an inch thick.

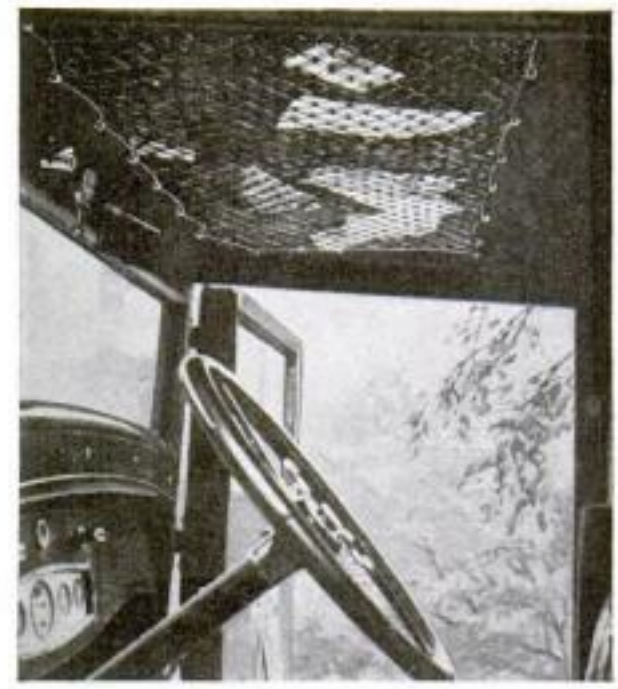
STARS THAT BEAT WOULD BURST IF THEY ROTATED

STARS, like many human beings, cannot do two things at the same time. Astronomers have long known that some stars turn on their axes, while others pulsate like gigantic hearts. But the same star cannot do both. So Dr. Ross Gunn, of the Naval Research Laboratory in Washington, has reported to the American Physical Society.

This helps to explain the puzzle of the Cepheid variable stars, which are believed to pulsate. But if they were also rotating, the strain of centrifugal force probably would burst them apart.



The V-shaped ribs on the tip of this screw driver give a grip that stops skidding on screw head.



NET, HOOKED TO CAR TOP, HOLDS MANY ARTICLES

WHAT the closet does for the house a new suspension net does for the automobile. Attached by metal hooks to the bows supporting the top of the car, it carries papers, clothes, packages, blankets, maps, and other small articles. Furthermore, it carries them in a neat, safe, and compact position. It keeps articles in plain sight where they can always be found. There is no interference with headroom, its makers claim. The hooks attaching the net to the ceiling may be quickly screwed in. Thus seats need no longer be cluttered with miscellaneous packages, often misplaced or lost. The net, it is said, fits every make of car on the market.

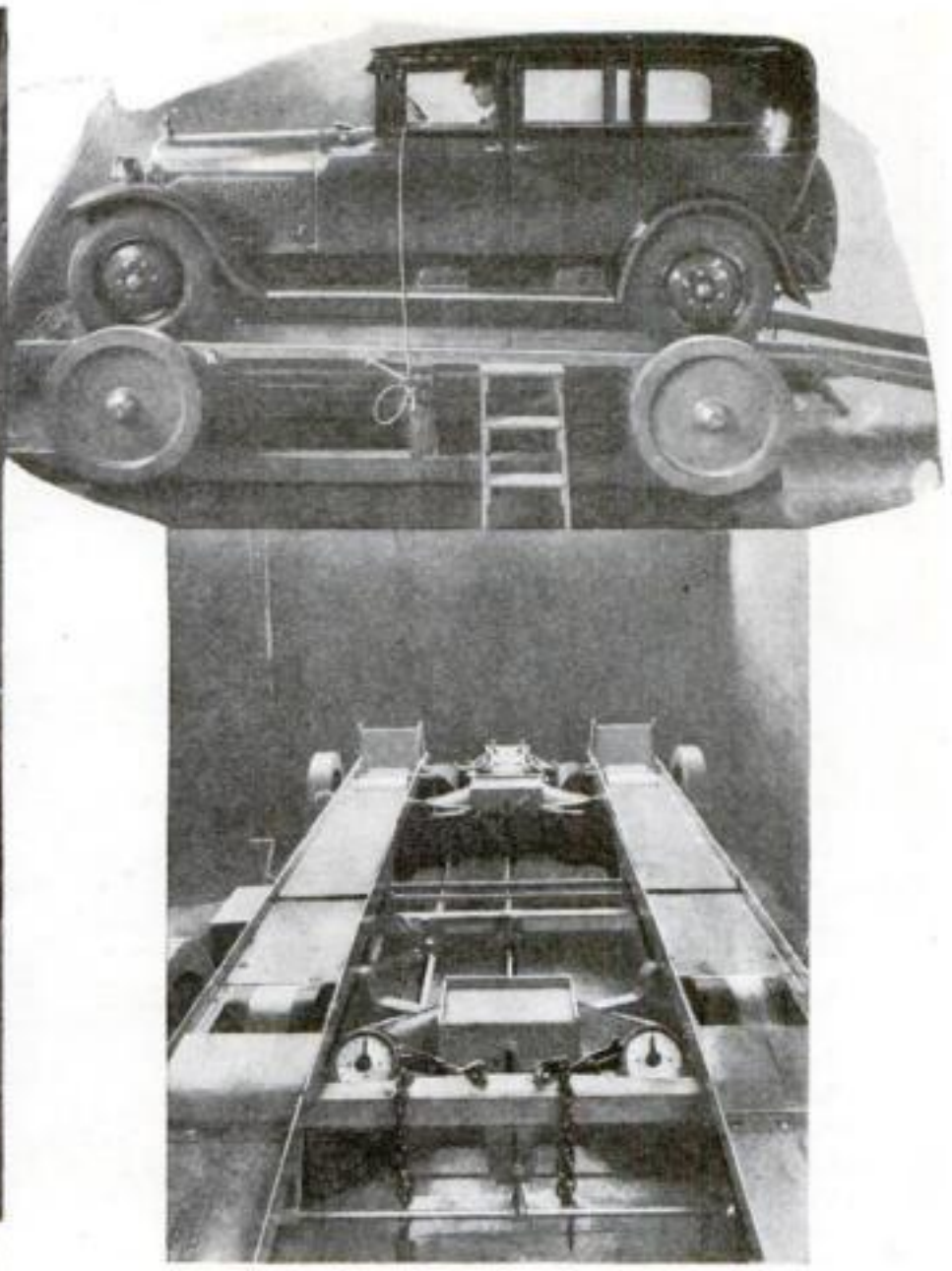
INSULATOR AND CONDUCTOR IN ONE SUBSTANCE

MOST substances are classified as "insulators" or "conductors" of electricity, depending on whether they confine or transmit it, but a new substance, known as "thyrite," is both. This novel material, according to K. B. McEachron, General Electric Company engineer, is an ideal safeguard for electric transmission lines. Ordinarily it acts as an insulator and prevents current from leaking. When the line is struck by lightning, however, thyrite becomes a conductor and allows the dangerous current to escape harmlessly to the ground.

Thyrite looks like porcelain and has the color of black slate. It is molded by a complicated process from a number of materials, including silicon carbide, a commonly-used abrasive called by various trade names. When adapted for use as a line protector the tips of a piece of thyrite are sprayed with metal and form the contacts.

Because of its peculiar constitution, it behaves much like the common lightning arrester that protects radio outfits, in which a small gap bars discharges of low voltage but allows high ones to pass. In thyrite this seems to be a structural property of the material itself. It violates the familiar electrical law that doubling the voltage applied to a conductor increases the current to twice the amount; in thyrite, this increases the current a fraction more than twelve times.

How Fast Is It Safe to Come Up? In a compressed air chamber at the Washington Navy Yard, sailors learn how rapidly they would be able to ascend from a sunken submarine. Too rapid travel from deep to shallow water would cause "bends." The men are wearing Momsen "lungs," new rescue device.



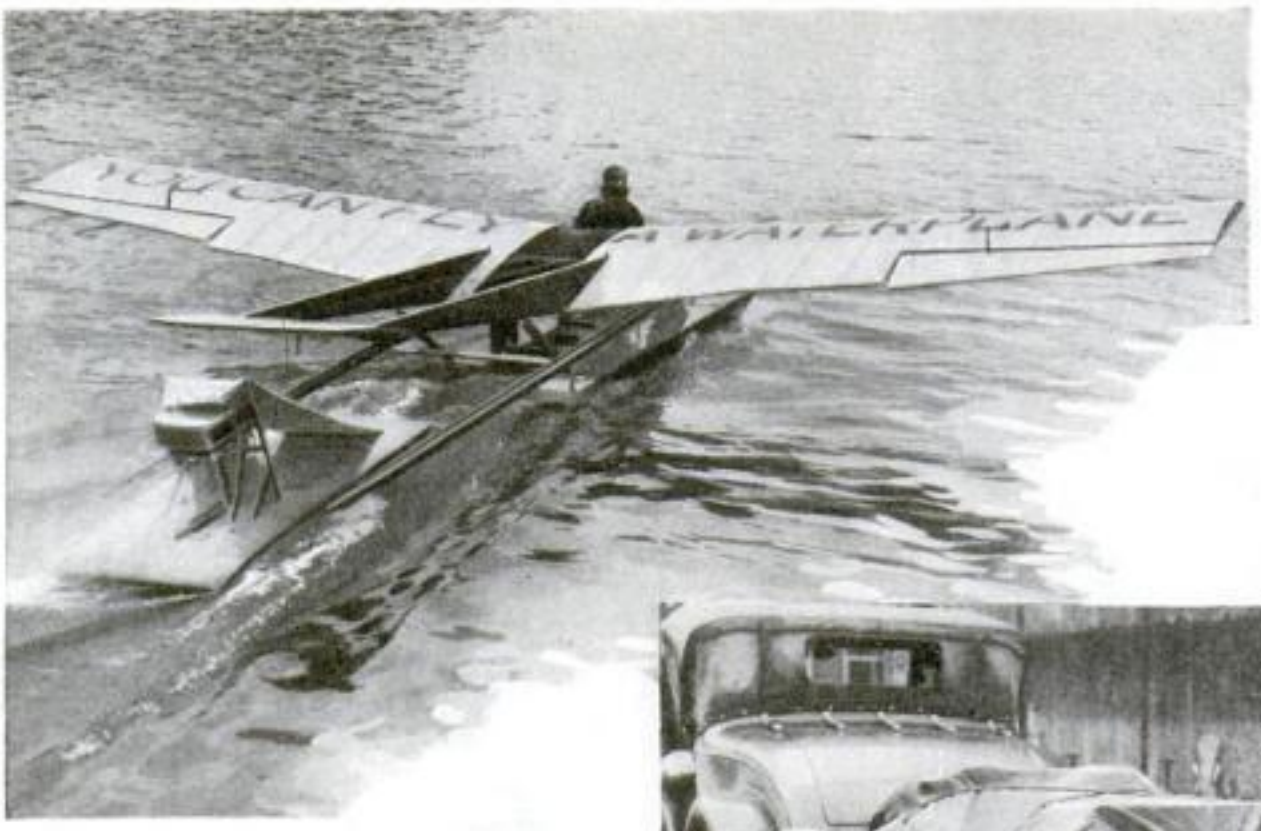
New Brake Tester. Four heavy flywheels in this device measure the brakes' holding power. Spun by the car's wheels, they simulate the momentum of a moving auto. When brakes are applied, recorders show how long it takes to stop the flywheels.

Vacuum Printing Machine. A Brooklyn, N.Y., air map firm uses this device in making large prints. With negative and paper in place under glass, an air pump creates a vacuum, forcing perfect contact. A rubber blanket keeps the pressure uniform. Note gage at lower right.

Robot Traffic Guide. This device, worked by levers buried in the roadway, "feels" approaching cars and flashes them a "go" signal if traffic is clear. It takes the place of a traffic cop and shows almost human judgment in its operations.

Proving a Singer Can Sing. The tonoscope, developed at the University of Iowa, measures a singer's pitch and detects the slightest off-key note. Rows of holes are arranged on a rotating cone above each other and illuminated from inside. The row of holes that correspond to the tone rendered appear to stand still.

NEW IDEAS AND INVENTIONS



WINGED OUTBOARD MOTOR CRAFT SETS NEW RECORD

AN ENORMOUS dragon fly with a human head has been seen recently flitting about the waterways of Alameda, Calif. It is the "waterplane," a new type craft able to make sixty-five miles an hour with an outboard racing motor. Two wide, flat-bottomed pontoons joined in tandem by sturdy struts make up the "chassis," from which typical airplane wings spread laterally. The outboard motor is placed on the rear pontoon. The wings are said to contribute to the high speed of the craft. A genuine airplane thrill is claimed.

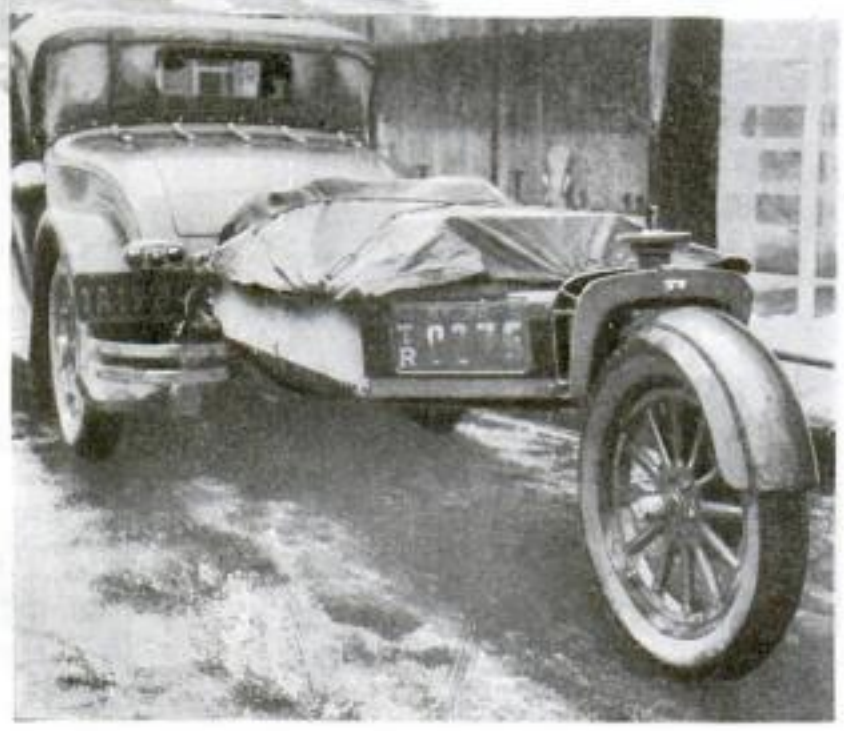
VERTICAL HEADLIGHT ON ENGINE TO WARN AUTOS

MOTORISTS who see, at a grade crossing, a locomotive pass with its headlight pointing up in the air need not be surprised. The Pennsylvania Railroad plans to test the suggestion that a perpendicular beam of light may be an effective warning to motorists on highways that cross the tracks.

The plan is to equip a passenger locomotive with a vertical headlight and run it over Ohio lines. For 700 or 800 feet the beam of light will ascend toward the clouds. Experts believe that this beam will be visible to approaching automobile drivers at a much greater distance than a horizontal shaft of light.

GAS TANK LOCKING CAP WILL THWART THIEVES

A DEVICE to thwart gasoline thieves has recently been invented. It is a new type of locking cap for gas tanks that can be opened only by its own key. The cap was originated as a means of preventing illegal gas leakage of all kinds. In case a car is stolen, the locked cap would prevent refilling of the gas tank and hence the car could be run only as far as the gas already in the tank would carry it. The novel cap may be procured for both automobiles and trucks.



NEW TYPE AUTO TRAILER HAS ONLY ONE WHEEL

AN AUTO trailer which has only one wheel appeared recently on the market. This versatile wheel adapts itself to any situation. The body of the trailer is attached rigidly to the automobile in the horizontal plane, remaining fixed no matter which way the car goes. It is claimed that the new trailer is easier to maneuver than the familiar two-wheelers. Tourists, campers, and merchants may all find it in designs suited to their needs.

TREATED WITH HEALTH RAYS, ICE CREAM CURES RICKETS

EVEN ice cream is now treated with the rays of artificial sunshine to make it more healthful. When samples of about one ounce each were given from fifteen seconds' to ten minutes' exposure to ultra-violet or health rays emitted by a mercury vapor lamp, F. C. Button, of Morehead, Ky., and two associates found, recently, that they made effective doses to cure rats of rickets, a bone disease that also affects humans.

New type cap for gas tank of a car locks on and can be opened only with the key, thus preventing theft.

RUSSIA'S GIANT DYNAMOS BIGGEST IN THE WORLD

THE first hundred-thousand-horsepower dynamos ever designed for hydro-electric power are under construction for a Russian power plant on the Dnieper River, according to a recent announcement of the General Electric Company. These titans will be nearly half again as large as the huge machines at Niagara Falls, N. Y., for many years the biggest of their kind in the world, and will far outclass in individual size, though not in number, the great turbines of the Conowingo, Md., plant described on page 49 of this issue.

Four of the turbine-and-dynamo sets are being built. The power plant is to be erected at Kichkas, in the Ukraine, where, under the direction of American engineers, the last of the turbines is to be installed in 1932.

Each generator will be forty-two feet in diameter at its widest part and will weigh 1,760,000 pounds. The steel shafts which couple each dynamo to its water wheel turbine are thirty-six feet long.

2,000,000 PERSONS' THOUGHTS EQUAL ONE LAMP POWER

IF TWO million persons were to think of the same thing at the same time, they would generate, collectively, enough electrical voltage to light one ordinary incandescent lamp.

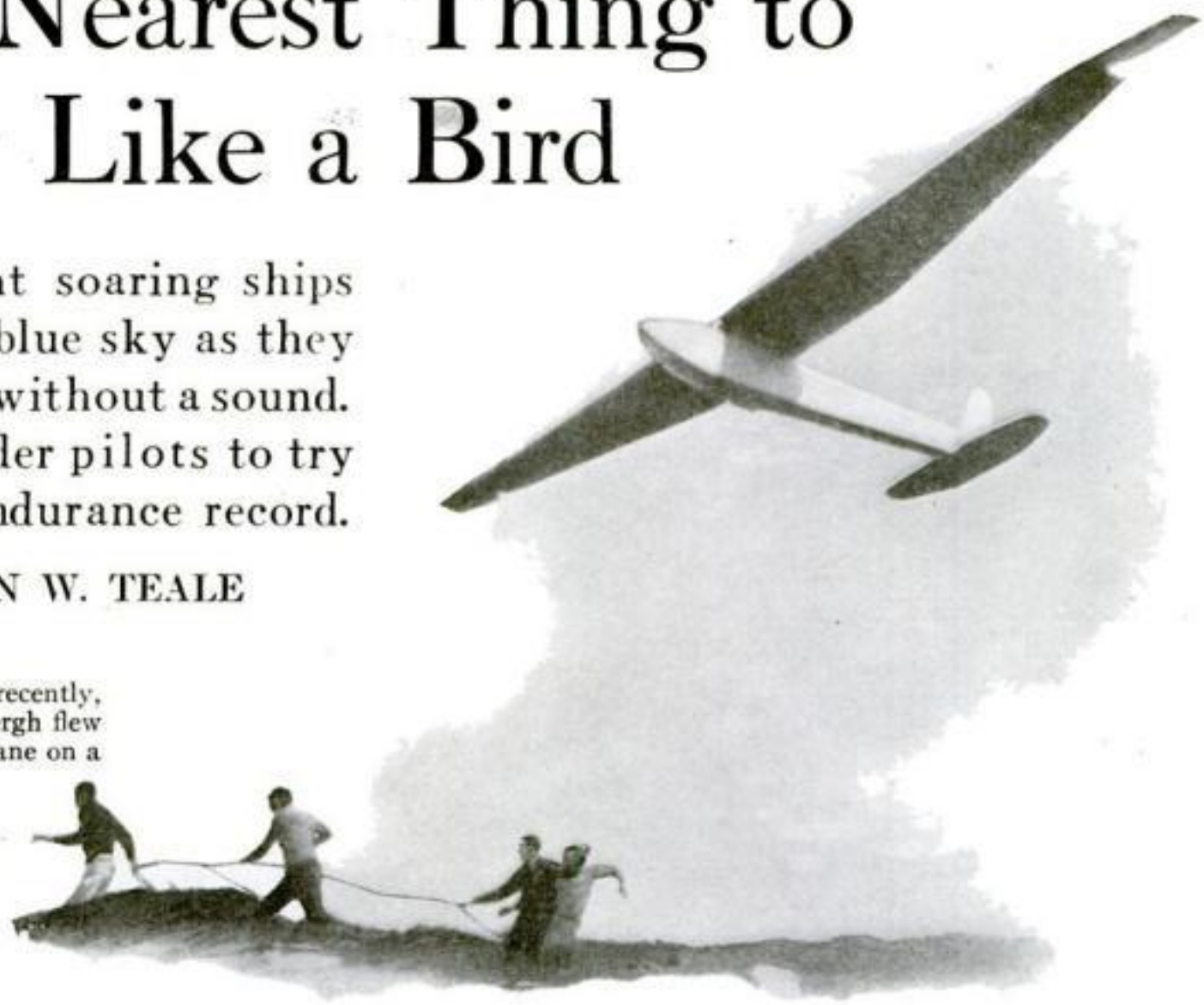
This is the conclusion of Dr. Edmund Jacobson, of the University of Chicago, who says he has shown, after two years of experimentation, that a measurable electric effect accompanies human thought. In his experiments he used a "string gavanometer," that can measure a millionth of a volt of electricity.

Subjects in Dr. Jacobson's laboratory had electric contacts attached to the right biceps or pulling muscle of the arm, the other end of the wires being connected to the galvanometer. At a signal, a subject would try to imagine that he was flexing his arm. A quartz string in the recording instrument vibrated in response to the electric impulse this mental effort generated. When the subject stopped thinking, the string was still. According to Dr. Jacobson, the thought of flexing the muscle was what induced the electric discharge. He succeeded in measuring its value and even in throwing the image of the vibrating string on a screen so that a subject could "see himself think."

It's the Nearest Thing to Flying Like a Bird

Featherweight soaring ships spiral in the blue sky as they ride the wind without a sound. American glider pilots to try for a world endurance record.

By EDWIN W. TEALE



Mrs. Lindbergh taking off in the flight which won her a first-class license at San Diego, Calif.

ALONG the California coast, recently, Colonel Charles A. Lindbergh flew his new Lockheed monoplane on a peculiar quest. A few weeks ago, with W. Hawley Bowlus, America's foremost glider pilot, he established a mountain camp at Lebec, Calif., to learn the technique of soaring. Then he began flying over the headlands and hills of the seacoast looking for the best spot for an attempt to break the world's endurance record for motorless planes, now held in Germany by Hermann Dinort at fourteen hours and forty-three minutes.

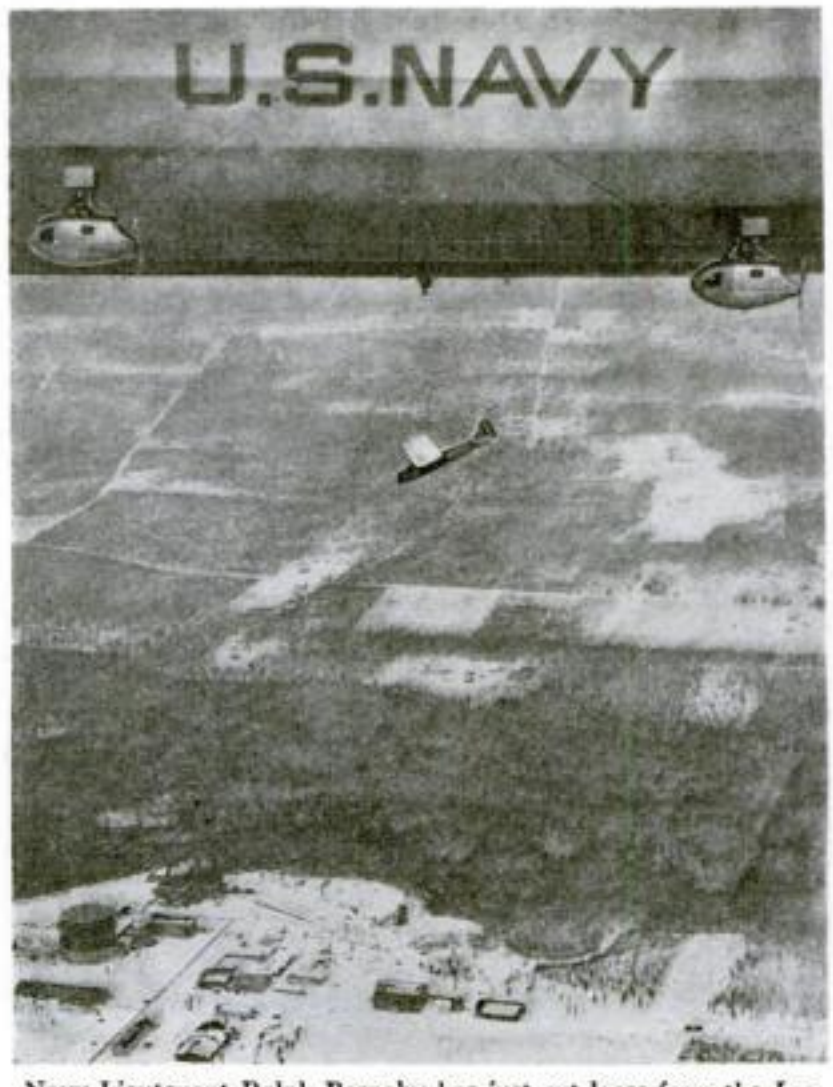
Meanwhile, members of the POPULAR SCIENCE MONTHLY-New York University expedition are seeking a suitable location near New York City for the first National Soaring and Gliding Meet to be held late this summer. Travis Hoke, Editor of POPULAR SCIENCE MONTHLY, has been asked by the National Glider Association to head this search. In a few weeks, another motorless plane contest will be held at Bayside, Long Island, N. Y. Soaring and gliding stars from all over the country will compete.

At this contest, Lieut. Ralph Barnaby will repeat his spectacular feat of cutting loose from the dirigible *Los Angeles* and spiraling to earth, using the glider he piloted in his recent successful tests at Lakehurst, N. J. Capt. Frank Hawks is also expected to complete his proposed double transcontinental glider flight, towed behind an airplane, in sufficient time to take part in the Bayside contest.

WITH the members of nearly forty gliding clubs affiliated with the National Glider Association, scattered from coast to coast, making exciting hops down hillsides in primary training gliders and hoping to pilot the delicate, featherweight soaring ships that ride the wind for hours, interest in this type of craft is increasing daily.

Soaring is the nearest approach to bird flight man has yet achieved. Under ideal conditions, it means spiraling in the blue sky, high above valleys, woods, and villages—soaring without a sound, except the rustle of wind along the wings, mile after mile in hawklike flight.

The longest cross-country journey ever accomplished in a motorless machine, however, was made under far from ideal conditions. Robert Kronfeld's 102-mile flight over central Germany, last summer, began with a nerve-tingling race with a thunderstorm. As he was launched from Mount Wasserkuppe, in the Rhoen Mountains, rain began to patter on the wings and fuselage of his machine, and the force of the wind increased.



Navy Lieutenant Ralph Barnaby has just cut loose from the *Los Angeles* at 3,000 feet. In 12 minutes he glided to Lakehurst port.

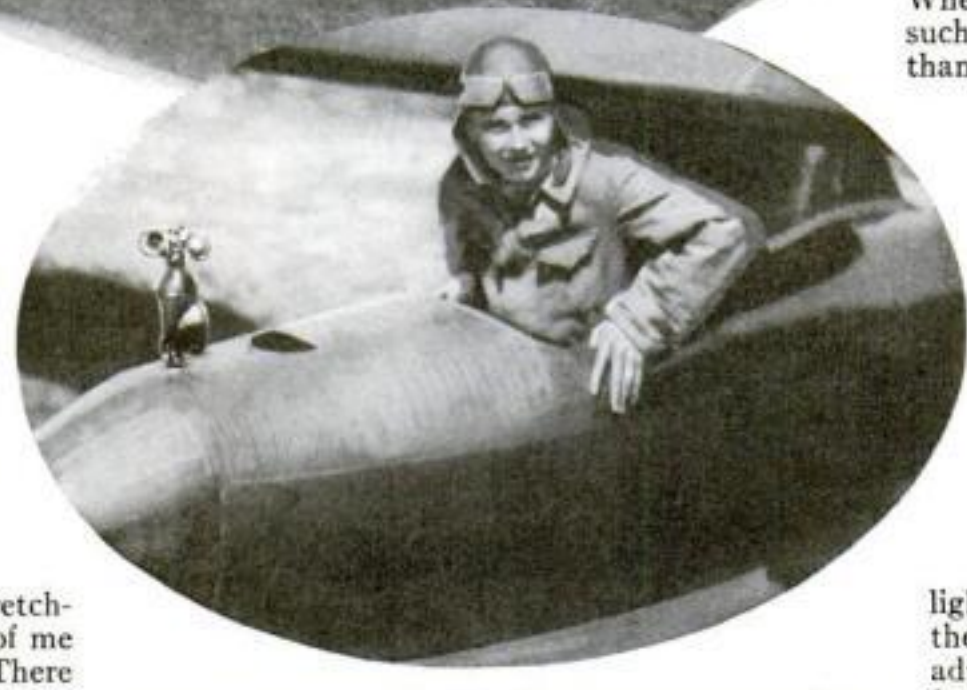
"There is thunder on all sides," Kronfeld writes in his story of the flight. "Fantastically built clouds crowd together behind me. They come nearer and nearer. The altimeter climbs without stopping. The higher I get, the quieter it seems. I can see over the stormy clouds on both sides. I already can see that it extends from west to east and way out north. I spot the town of Berka far down below me. I am already 4,500 feet above the starting point. Small white clouds, like pigeons, arise below me. Wrecked clouds are whirling around me. They are getting denser and denser. A glance to my right and left shows me there is no longer a chance to escape.

"I am trying hard to keep straight ahead eastward, but it seems impossible. The compass runs around in a circle. A howling noise is commencing around me. My speedometer starts trembling, jumps to fifty, sixty, and seventy miles an hour. By pulling up the machine, I try to lower the speed. I have a feeling I am standing with my feet against the sky. I am getting pushed down by some irresistible pressure against my

At a Rhoen soaring meet a big gallery of spectators watch the light sailplanes hurled into the air by long rubber cables.

seat. I start thinking of my parachute.

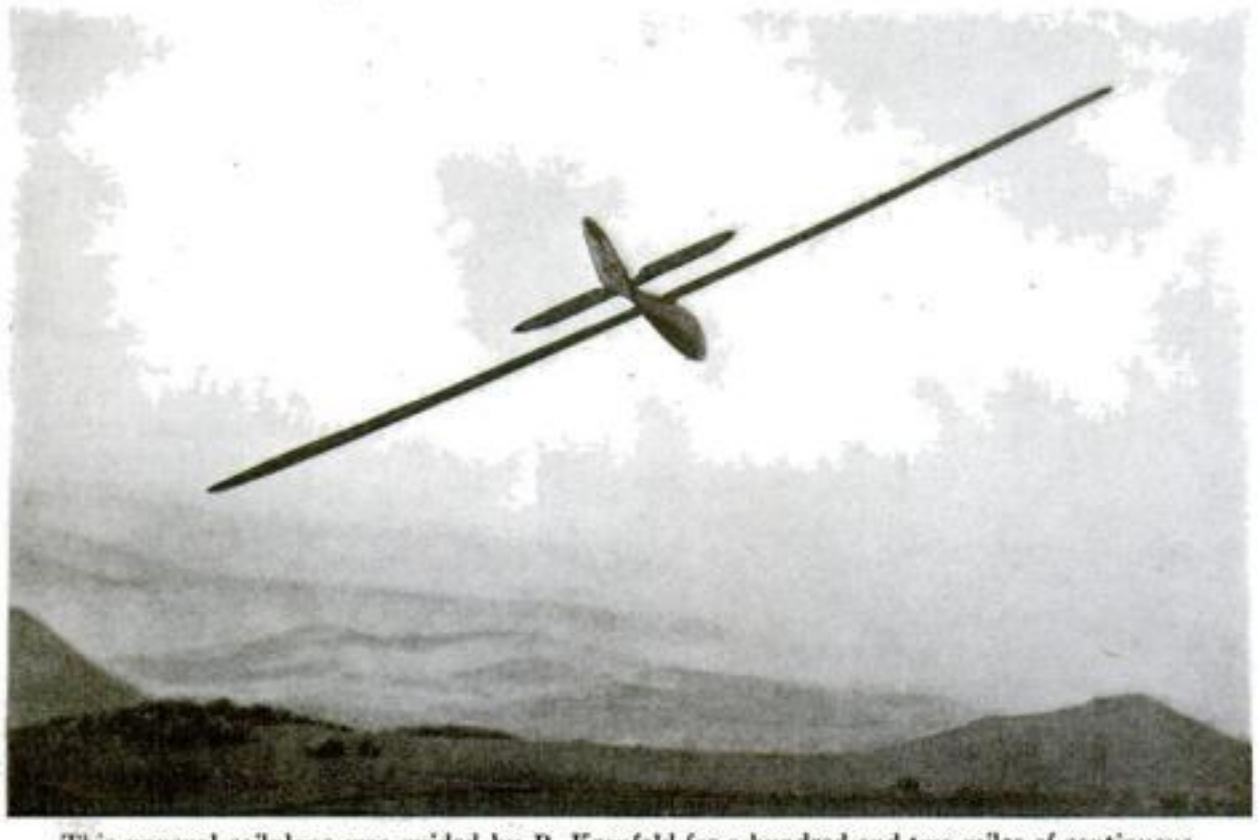
"Suddenly it becomes very quiet. My vision, as in a fever dream, is first very faint, then more distinct. Fields and gardens are circling around me. The town of Eisenach lies below me and I keep right on. My rain-soaked hair starts drying as well as my shirt. My teeth are chattering. Fields and towns pass by. My watch shows seven o'clock in the evening. The moisture of a hot summer day lies above the country. Time passes and it begins to get dark. Wide empty fields are stretching below me. The clouds in front of me are vanishing. I am coming down. There are woods below me, far away a town, a railroad, quite a large place just suitable for landing. A few curves and the ship slips through the grass. The flight is ended."



Max Kegel, famous "cloud flyer" of Germany, in the cockpit of his glider. Note the air speed indicator in front of him.

ANOTHER amazing record was set not long ago by this same pilot when he climbed to an altitude of more than 9,000 feet in his engineless ship. Other pilots have flown more than 300 miles, circling about, and have landed at predetermined spots. One flyer carried a passenger to a height of 4,000 feet and flew twenty-four miles across country with him. Over the sand dunes that border the Baltic Sea in northeastern Germany, the other day, a sailplane pilot jockeyed his craft for several hours while a passenger read to him from a book. Twice, motorless planes have flown more than fourteen hours. The first time this was accomplished the late Ferdinand Schulz, the ace of soaring men, was at the controls. Schulz was killed last summer stunting in a motored machine and not, as was first reported, in a glider crash. The second man to pass the fourteen-hour mark was Hermann Dinort. A few months ago, he soared over the Baltic dunes all night and weathered a violent storm to advance Schulz's endurance record more than thirty minutes.

At first the idea of flying without an engine seems absurd. But it isn't. The air is filled with invisible rising and descending currents. For instance, when a wind strikes the side of a hill, it is deflected upward and forms a strong lifting column of air. As a general rule, this upcurrent reaches to a height twice that of the object which deflects it. When a light sailplane enters such an updraft, it is lifted faster than it descends. Throughout its flight, a soaring plane is always gliding downward with relation to the air. It does not reach the ground because the pilot steers it from one rising current to another. The altitude lost between updrafts is regained in passing through them. In other words, the rising air current carries the soaring plane upward faster than it glides down. The perfect streamlining and the light plywood construction of the soaring craft allow them to advance as much as twenty feet for every foot they go down. This drifting descent permits them to soar long distances without losing much altitude and to pass slowly through rising air columns.



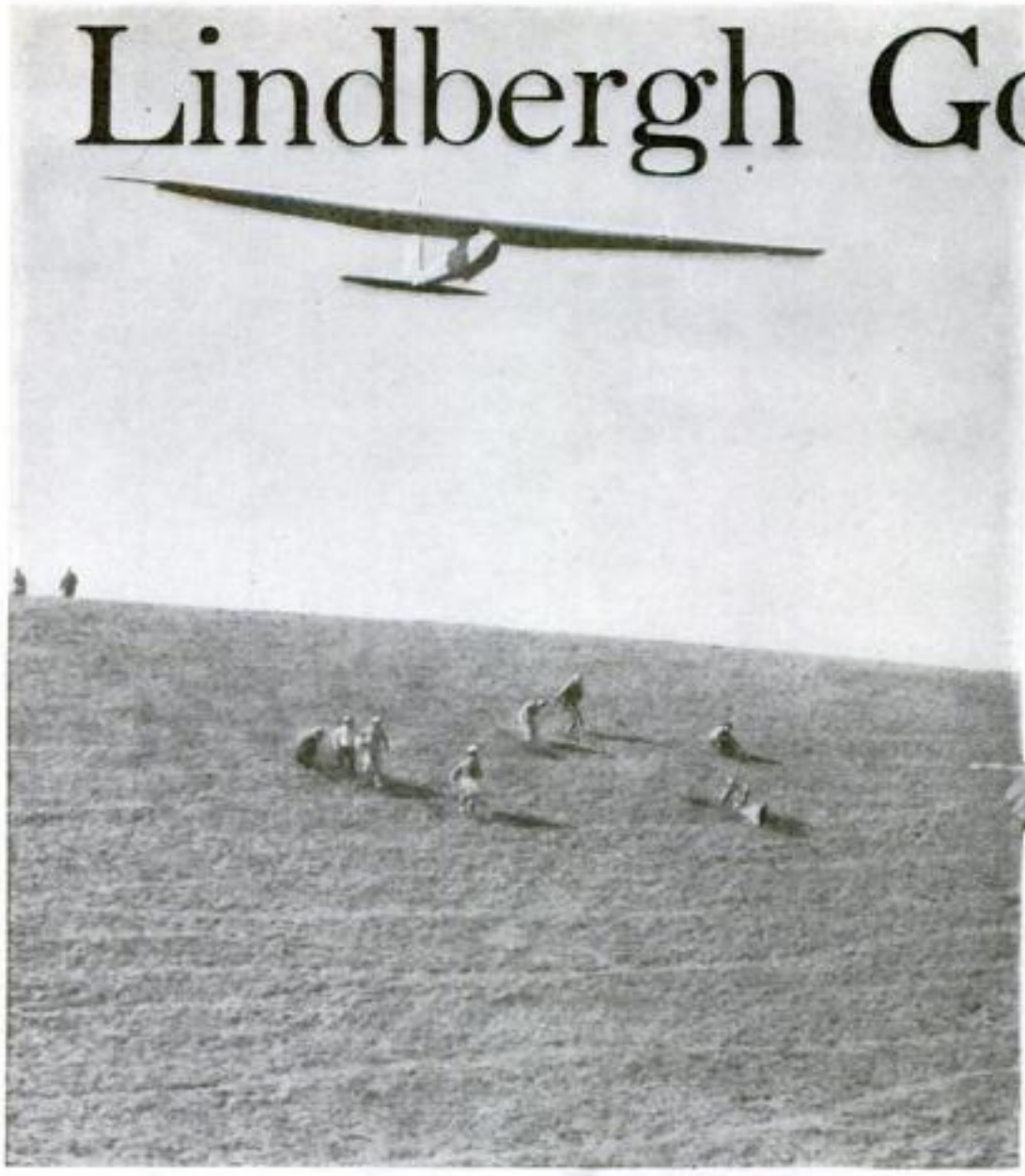
This unusual sailplane was guided by R. Kronfeld for a hundred and two miles of continuous flight over mountains, villages, and forests of Germany, in his effort to set a new record.

SOME of the lightest of these thistledown craft have strong cantilever wings that weigh only five ounces for every square foot of supporting surface. When W. Hawley Bowlus set a new American endurance record by circling through the dark over Point Loma, Calif., for nine hours and five minutes, guiding his flight by the flashing beacon of a lighthouse, he used a machine that weighed fifteen pounds less than he did. Bowlus weighs 190 pounds. The sixty-foot man-made gull, which he constructed in the factory where Lindbergh's famous *Spirit of St. Louis* was built, weighs only 175 pounds.

An experience of Orville Wright, the first man to fly an airplane, illustrates the almost unbelievable power which rising air currents exert in reference to aircraft. In 1910 he was descending from an altitude of about 1,500 feet near Montgomery, Ala., when he suddenly discovered he was unable to come down any further. "My motor was throttled to the limit," he writes, "and the machine was pointed down as steeply as I felt it safe to point it. I remained at this height for a period of five minutes without any appreciable descent. Suddenly the machine began to descend and was on the ground in less than a minute." His explanation is that he had run into a huge column of rising air of greater diameter than the 500-foot *(Continued on page 152)*

Lindbergh Goes Gliding

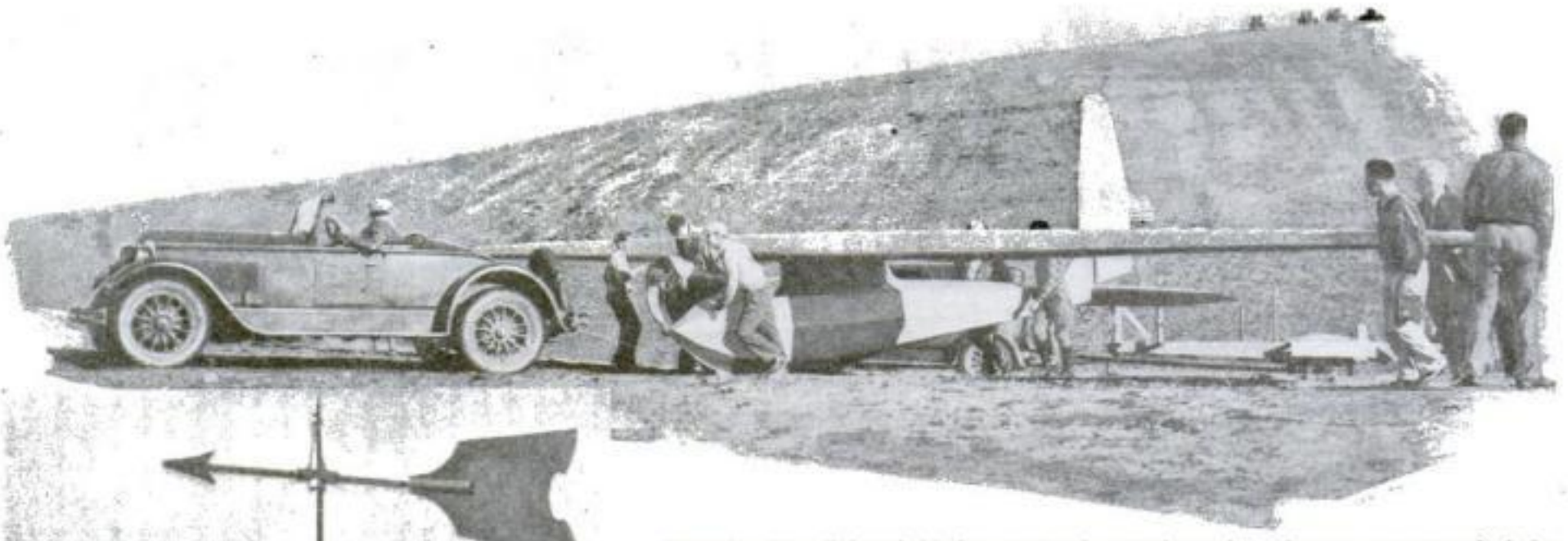
Three Pages of Pictures Tell the Story of the Lone Eagle's Life at Lebec, Calif., Where He Mastered the Art of Gliding



On one of his first flights Lindbergh soared fifteen miles over the Tehachapi Mts., where the American ace mastered the technique of the new sport of motorless flying.

Colonel Lindbergh, right, looking over the soaring country near Lebec, Calif., with W. Hawley Bowlus, America's foremost flyer of motorless airplanes.

Above, Lindbergh is working on a wing of the glider that cracked during an experimental flight. In circle, the Colonel is helping Bowlus hook up the glider controls. At right, after the flying is over, the Lebec campers, with Mrs. Lindbergh at the table, center, and her famous husband, left, are resting.



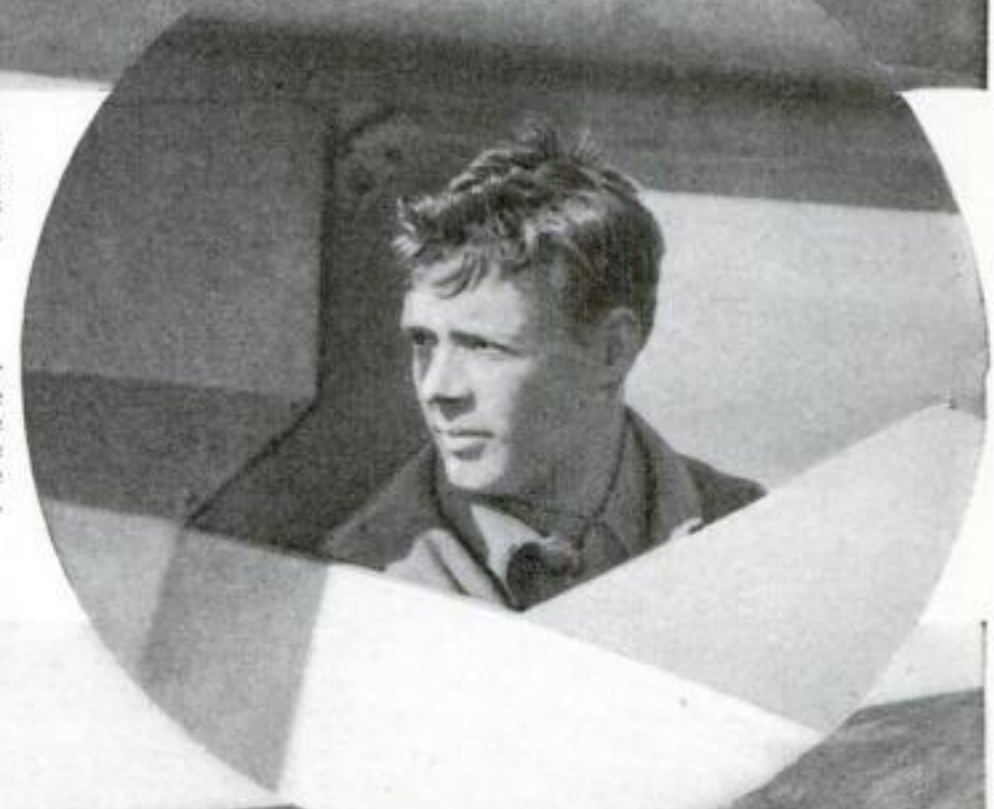
Dragging the sailplane behind a car to the starting point, where runners stretched the heavy rubber cable that shot the light plane out into rising air currents at the top of a hill.

Dr. Alexander Breese, Government weather expert, installing the anemometer and vane which showed Lindbergh direction and force of the wind so he could plot the best course.

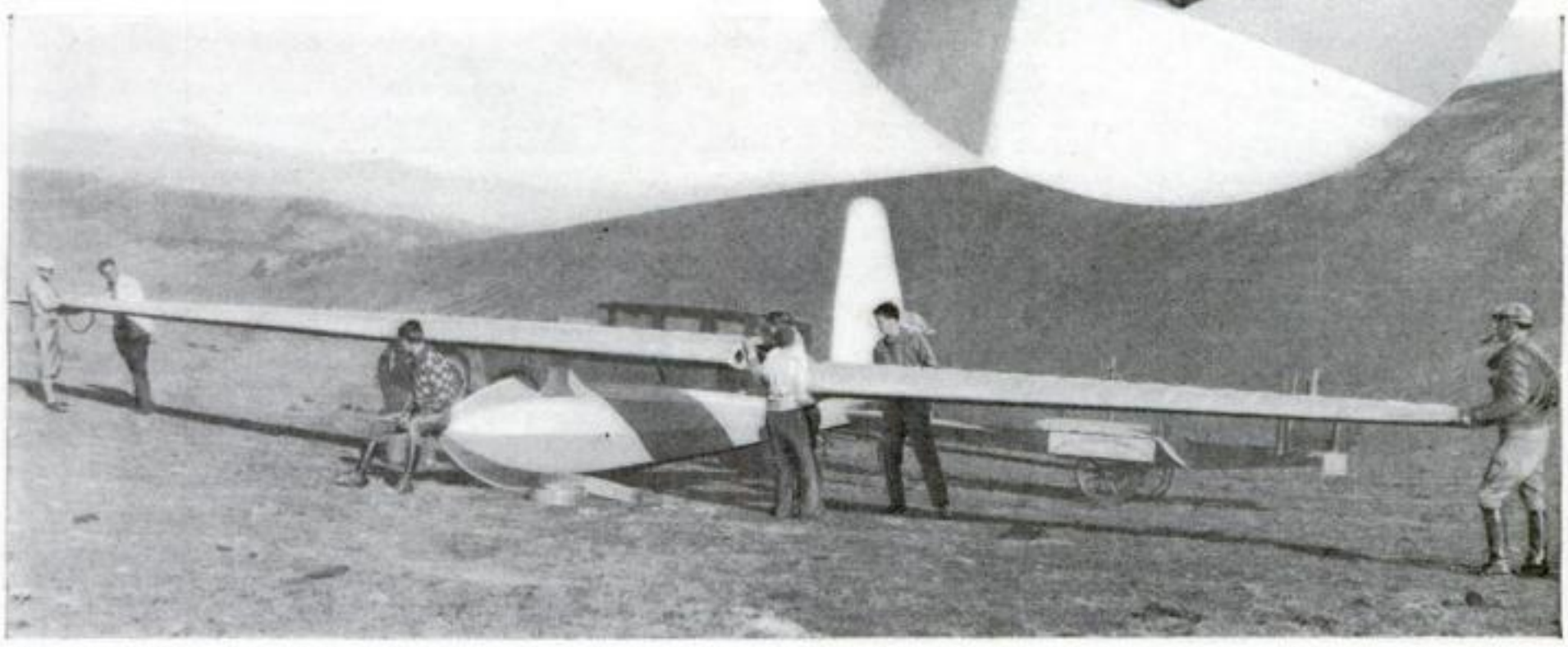
Above, Mrs. Lindbergh is an interested observer of the experimental glider flights near Lebec. At left the great flyer is hard at work soldering a wire in assembling the engineless sailplane which he flew.

Above, attaching shock cord to nose of Lindbergh's glider just before he took off. Left, Lindbergh and Bowlus at work assembling the sailplane.

This remarkable photograph, one of the most beautiful ever made of a glider in soaring flight, shows Colonel Lindbergh maneuvering a motorless airplane above the foothills of the Tehachapi Mountains, Calif. On the rising currents of air thrown up by hillsides such as these American glider pilots hope to set a new world's endurance record of more than fifteen hours.

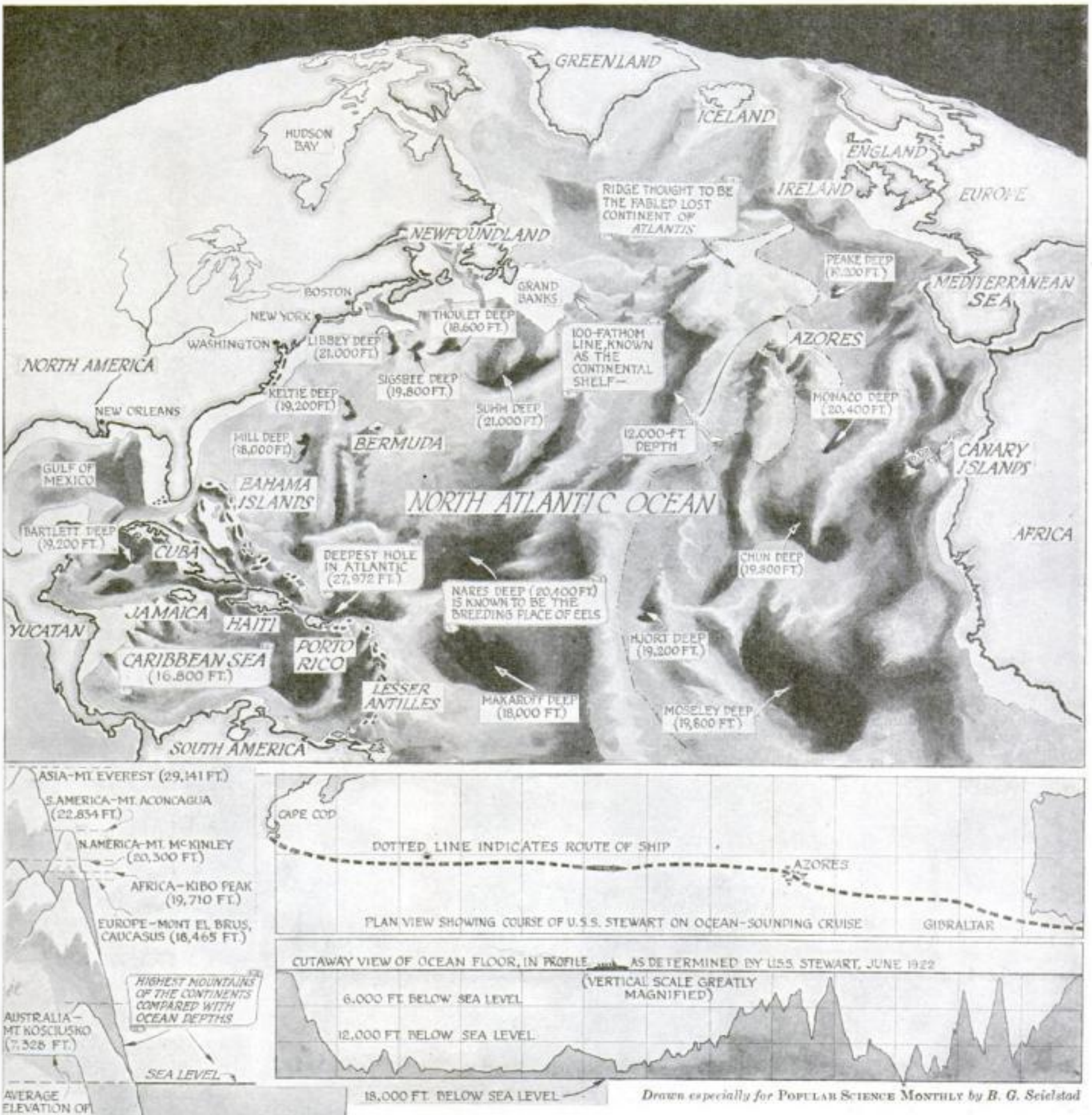


Lindbergh seated in the sailplane waiting for the take-off of an early flight in which he sailed fifteen miles, circled a mountain lake several times, and stayed aloft twenty-one minutes, before he swooped down for a gentle landing in a field in one of the valleys below.



When any repairs were necessary on the gliders, Lindbergh was always on hand to help make them. Here he is seen, near the center, assisting in putting a new wing on the soaring ship which was used in the gliding experiments at the Lebec camp. The machine's main wing measures sixty feet across.

If the Ocean's Floor Were Dry

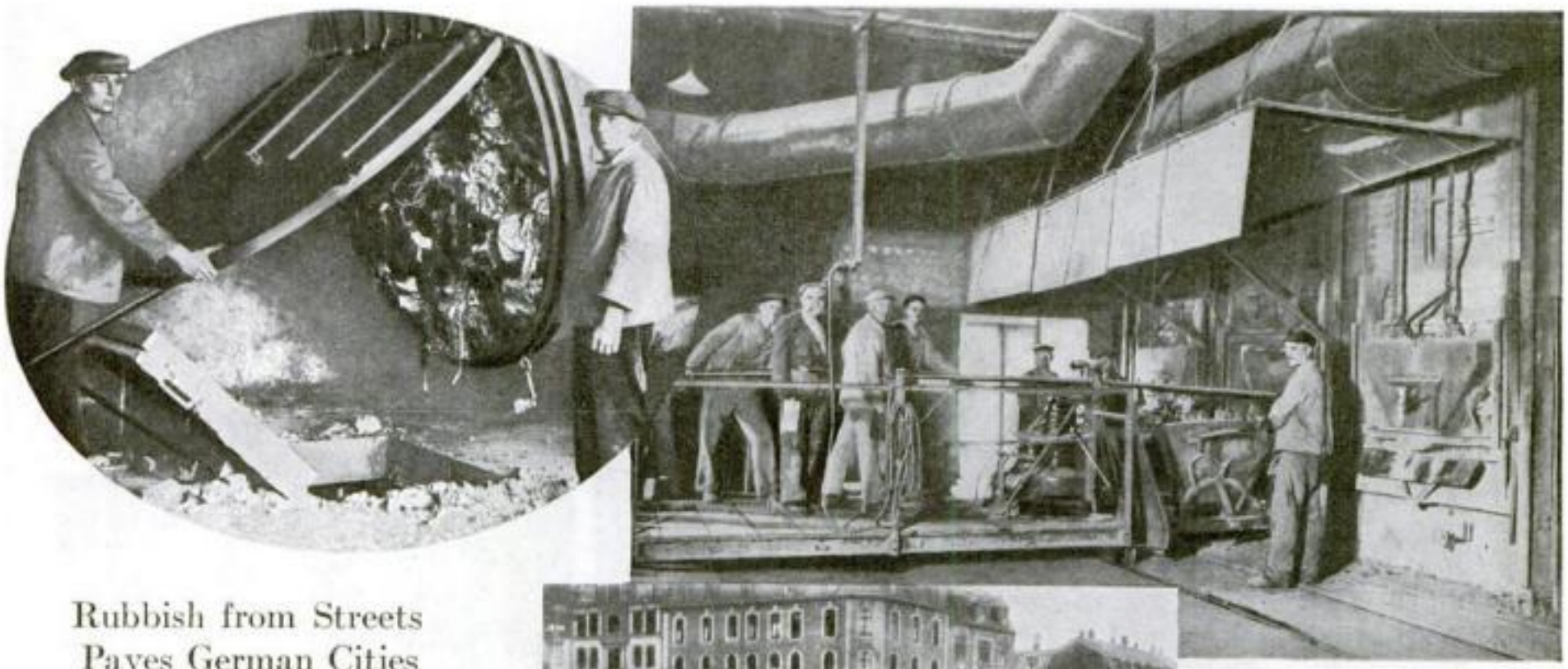


Drawn especially for POPULAR SCIENCE MONTHLY *by B. G. Seielstad*

SOUNDINGS of the Mindanao Deep in the Pacific Ocean, near the Philippines, proved recently that the sea's greatest depth is 35,410 feet, which is just short of seven miles. In such a hole the highest peak would be lost more than a mile below the waves. From the top of Mount Everest to the bottom of Mindanao Deep is a vertical drop of a little over twelve miles. Accurate and rapid measurement of these great depths was made possible by the "sonic depth finder," a device, developed during the World War, that uses the echo from the ocean's floor in making its soundings. On this page is a suggestion of what the bed of the North Atlantic would look like if the water were drained away. A great pit, 27,972 feet deep, would be found near Porto Rico, marking the spot of the Atlantic's greatest depth. A plateau would be found near the Azores and a vast table-land would appear near Newfoundland. A typical cross section of the ocean is shown above. This was made by the United States warship *Stewart* in 1922, and in spite of enormous depressions, it proves that great stretches of the ocean's floor are comparatively level.

PROGRESS AND DISCOVERY

Important achievements in engineering, exploration, and discovery, and the latest news of the world's progress in science



In oval: Unloading a truckload of rubbish at the Elberfeld-Barmen plant. The huge ovens above reduce it to ashes from which building materials that are worth millions of dollars are manufactured.

Rubbish from Streets Paves German Cities

NATURE, the supreme economist in conserving waste matter and reconverting it by chemistry into new uses, has been well patterned by a "reclamation" plant on the outskirts of Berlin, Germany, where untold tons of rubbish salvaged from the city streets are transformed into building materials. The industry literally rescues from the scrap heap millions of dollars each year. The refuse is burned in huge ovens, the ashes forming the basis for bricks, pipes, and other construction materials. In 1929 the plant produced 3,333,333 paving blocks, used for the paving of streets throughout Germany.

Here are some of the finished products salvaged from German refuse: paving bricks, conduits, and wall partitions.

Found—"87," One of Two Missing Elements

"ELEMENT No. 87," one of the two long-missing items in the chemist's catalogue of ninety-two fundamental substances of which all things on earth are made, is reported found at last. Dr. Fred Allison and Prof. E. J. Murphy, of the Alabama Polytechnic Institute, have discovered it in samples of ore from Maine and have named it "ekacaesium," although as yet they have not succeeded in isolating it from the ore. Their discovery, if confirmed, leaves only element number eighty-five to be hunted by the chemical explorer.

The search for missing elements has been romantic. As early as 1870 the Russian chemist Mendeleeff found that when the sixty-three elements then known were arranged in a nine-column table in the order of their atomic weight, whole rows of them were strikingly alike in chemical and physical behavior. Blank spaces appeared, however—both in this ingenious table and in a later scheme of arranging elements according to the number of free-spinning electrons they possessed—from hydrogen with only one electron to the uranium atom with ninety-two. It was but logical to conclude that there were in all ninety-two elements—that the blank spaces represented unknown elements and that from the tables their properties could be predicted before they were discovered.

Confirmation of this theory came swiftly as one after another the "missing" elements were discovered. In every case their properties proved remarkably like those predicted. The latest, ekacaesium, fits into the list between radium and radon (radium emanation) and is the sixth heaviest of all atoms.

Now only one is missing. Chemists are reasonably sure that the complete list stops at ninety-two and that nothing heavier or bulkier than the uranium atom can exist on earth; though more complex elements may possibly exist in the sun, stars, and elsewhere in the universe.

Aluminum Best Reflector for "Sunshine" Lamps

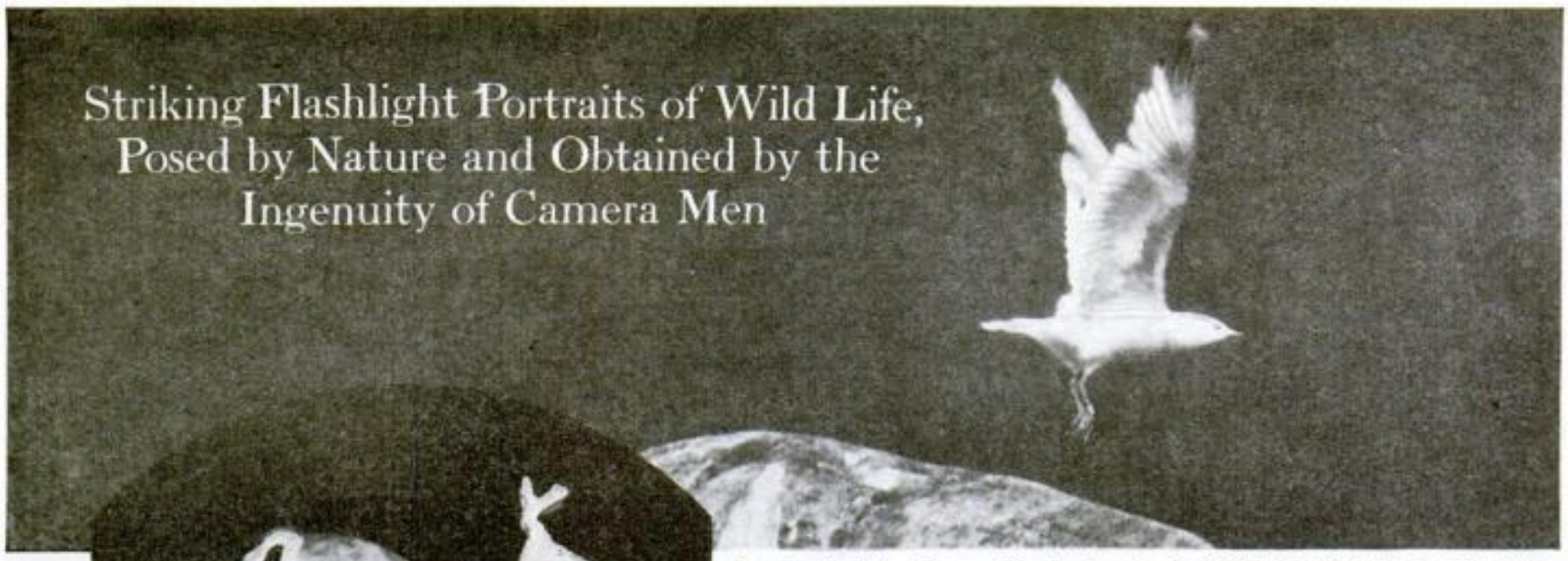
MIRRORS of aluminum, widely used as reflectors in artificial sunshine lamps, received a clean bill of health in a recent investigation by the United States Bureau of Standards. It was one of the first surveys to determine the ability of various polished metals to reflect the beneficial "ultra-violet" rays given off by such lamps.

Aluminum reflectors, the experimenters found, reradiated nearly fifty percent of the ultra-violet rays of medium wave length that fell upon them. This was considered a high figure. Another metal tested, rhodium, reflected from thirty to forty-five percent of the rays, depending on their wave length. Tin was classed as having a "fairly high" reflecting power but, tarnishing quickly, it loses its value as a reflector. In previous tests chromium as a metal reflector of ultra-violet light received a high rating, comparing favorably with aluminum.

Auto "Signals" Bother Radio Stations

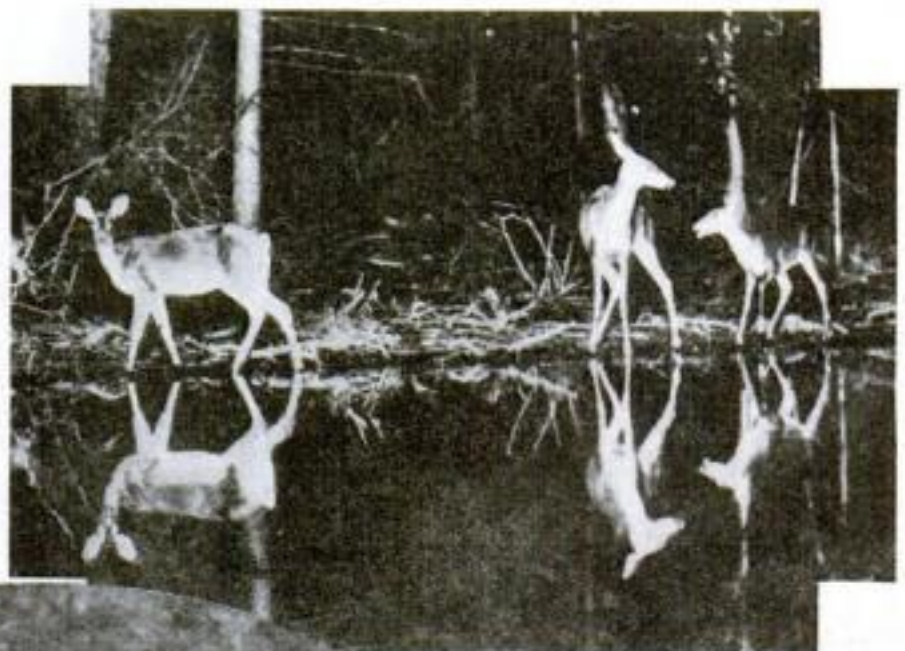
THAT motor cars on the highway may interfere with a near-by radio receiving station was revealed recently by Ralph Brown, of the research department of the Bell Telephone Laboratories. The trouble, he told the American Institute of Electrical Engineers, was that each car's ignition system, with its spark coil, was a miniature broadcasting station, and its "signals" came in nearly as strongly as weak short-wave radio signals from Europe. For that reason the transatlantic receiving station at Netcong, N. J., he explained, was purposely erected at a distance from automobile highways.

Striking Flashlight Portraits of Wild Life, Posed by Nature and Obtained by the Ingenuity of Camera Men



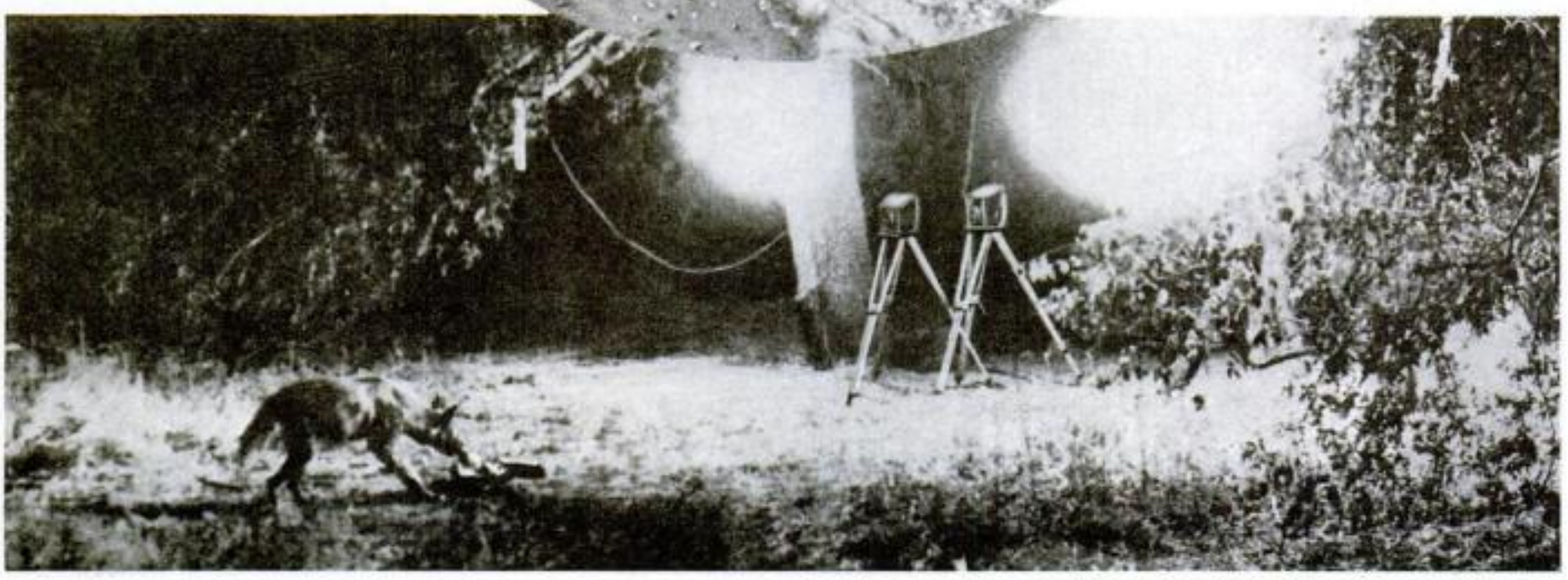
Posed entirely by Nature, this photograph of a bird in full flight is thought to be practically perfect from a technical and artistic viewpoint. Notice that the wings seem motionless and the camera proves that the feet hang down while the bird flies.

This startled fawn made a great effort to escape, but so fast did the camera work that the deer is caught in mid-air with its feet clear of everything but the splashing water, which, fortunately, did not spoil the unusual reflection.



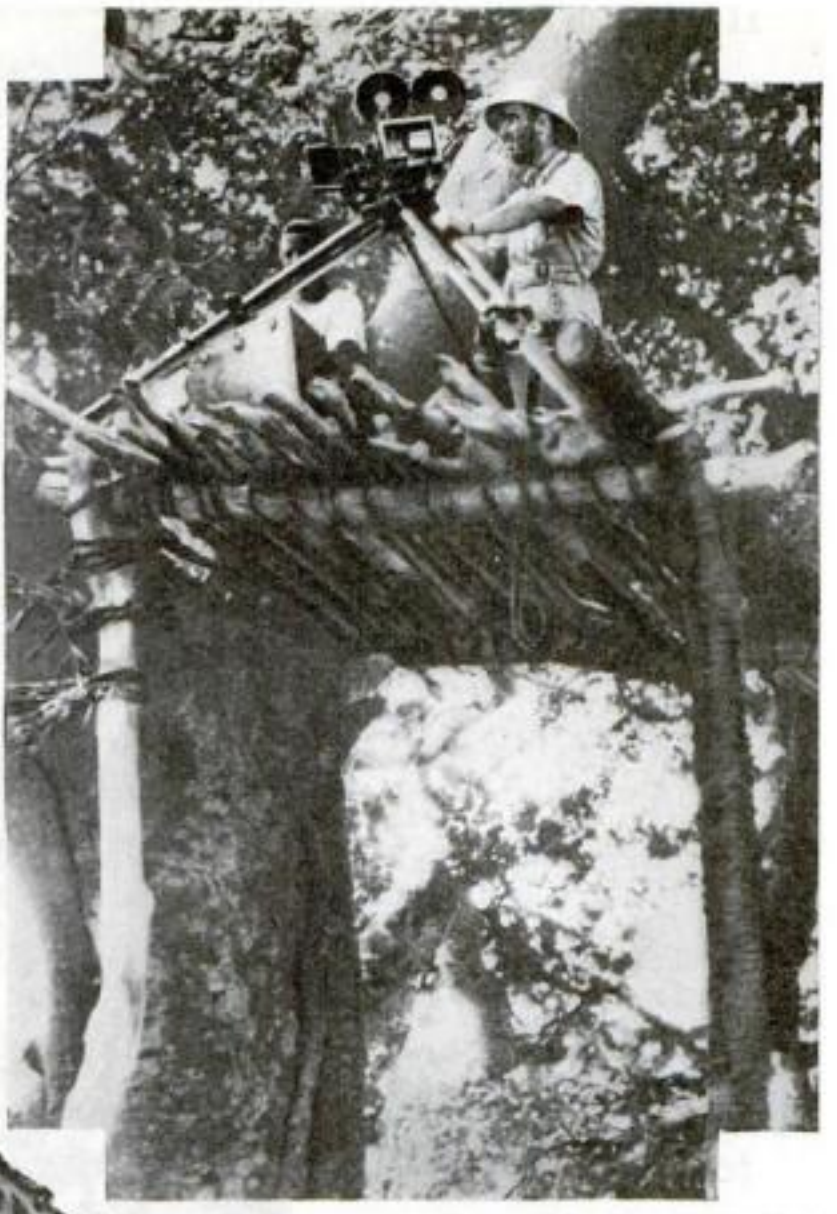
These does were not posing for this night picture, but the photographer stole up to them in a canoe and fired his flashlight. It was all over and they were filmed before they could move.

It is not praying. When the camera caught this thirsty hyena in Western Soudan, it was discovered for the first time that this strange animal kneels to drink.



This hyena, to its utter amazement, took its own picture. Tempted by hunger, it stole up to the cached food and, in the act of eating, moved a cord attached to a flashlight and camera shutter. Notice there is no blurring, as the astonished beast had no time to move before the photo was snapped.

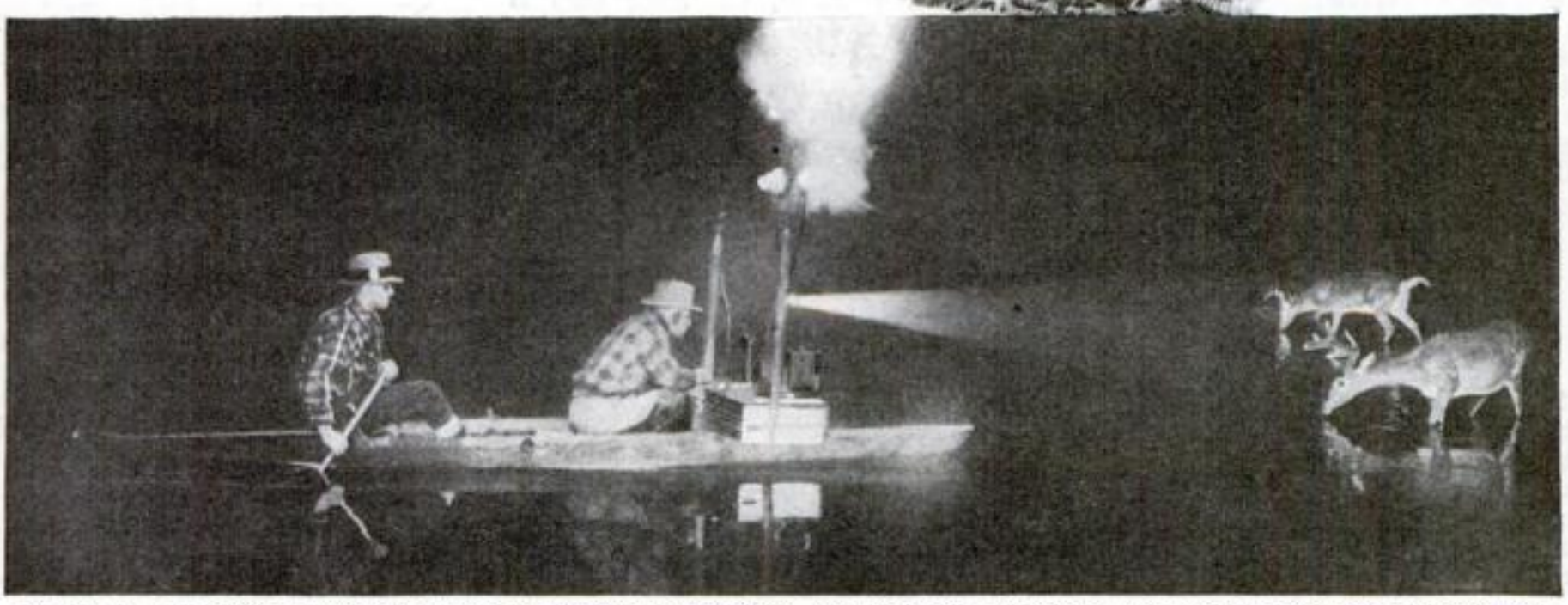
Mrs. Court-Treatt and her brother, Errol Hinds, are getting ready to hide a camera in the African woods. Waiting silently for the animals to come into view is the hardest part of this kind of hunting.



Hunting wild things in Africa with a camera calls for great ingenuity. Major Court-Treatt, head of the picture-taking expedition, sent out by the British Instructional Films, used this and similar hide-outs in making his remarkable photographs.

In this nest, only Mrs. Court-Treatt's face and the camera are visible. So natural was this station, that animals would approach within a few feet, as though wanting their pictures taken.

This young giraffe, still far short of the eighteen feet in height it may reach in maturity, was enjoying a nice meal in Africa when the camera got it. A little later its chase and capture were filmed.



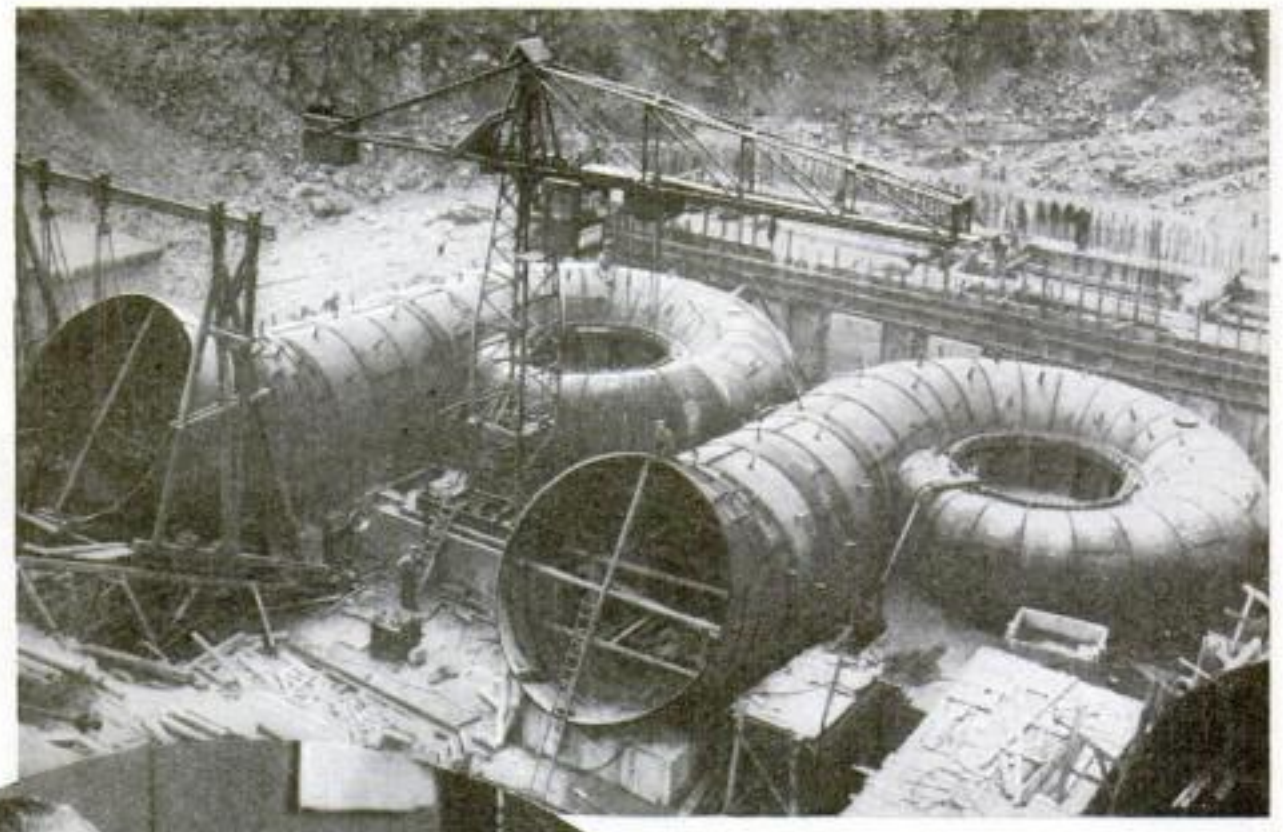
A quiet drink at midnight, rudely interrupted by the glare of a flashlight. So swiftly does the modern camera do its work that these deer were photographed before they could even raise their heads. This speed emphasizes the tremendous change in photography during the past century.

PROGRESS AND DISCOVERY

Huge Turbines Will Give Ireland Cheap Power

BESIDE the Shannon River, in Ireland, a great hydroelectric plant is rising, which is expected to bring an era of cheaper electric power. The wormlike scroll cases that will contain the turbines are ready to be connected to the tubes or penstocks that will bring water from the river which at this point has a swift downhill flow.

The illustration shows two of the scroll cases in place; a man on top of one of them, at the center of the picture, gives some idea of their size. The cases are solidly bedded in concrete to withstand the force of the rushing water. The penstocks will be bolted to these open mouths. Turbines of 38,600 horsepower will be installed in the center of the rings of pipe. Here fixed vanes, visible in the photograph, will direct the torrents of water against the blades of the vertical turbines. After use the water drops through wells into tailraces below. The great engines were built by a firm in Heidenheim, Germany.



These wormlike cases, on the Shannon River, Ireland, contain two 38,600-H.P. turbines. They will form part of a huge electric power plant.

Florida Sees Chance to Grow Rubber

THRIVING rubber plantations in Florida, now a hope, may yet be a reality. Para rubber trees planted there by the Florida Department of Agriculture are making encouraging progress, says Dr. Karl F. Kellerman, associate chief of the Bureau of Plant Industry in a recent report. He believes rubber trees will flourish there as well as in Haiti, although in Florida latticework is necessary to protect their growth. Haitian trees, he says, are as productive as those grown in the tropics, although not so vigorous.

A plant from Madagascar, yielding a superior rubber of the Para type, is now being grown in the Department greenhouses and in the Southwest. It is known as *Euphorbia intisy*, and in its wild state yields three to four times more than any other rubber. The plant is very rare and so far has not been cultivated on plantations. The Department, which now has only a dozen specimens, hopes to acquire more of the seeds.

Whale Now Furnishes Leather for Gloves

SEEKING to turn every part of the whale to profitable use, Norwegian whalers, with the aid of a Swedish chemical engineer, have perfected a process of converting the huge mammal's intestinal membrane into a tough, almost indestructible, and cheap leather for gloves. Ships now sent to the whaling grounds are floating factories, equipped to extract the whale oil, remove the whalebone, store and bring back the edible part of the beeflike meat, and turn the rest of the carcass into fertilizer.

This relief map of England is one of the twenty sections of a huge world map to be shown at Antwerp. Ship models, seen at the right, and 350 lights will give it reality.

Largest Map of the World to Be Shown in Belgium

A RELIEF map of the world, said to be the largest ever made, will be exhibited in the British government's building at the Antwerp exhibition in Belgium this year. Built in twenty sections at the workshops of the Overseas Trade Department, England, the huge map is forty-six by twenty-three feet, and shows mountains, deserts, rivers, and all other geographical features. One hundred and eight model ships and 350 electric lamps will add reality to the scenes which the gigantic map depicts.

The sections were packed in fourteen crates for shipment to the exhibition, and the cost, it is said, runs into four figures. At the Antwerp exhibition it is expected that practically all countries will be represented with scenes of their industries and science.

Robot Watchdog Fights When Light Hits It

"ROBOT" instead of "Rover" would be a good name for an electrical watchdog, exhibited at the recent radio show in Paris. Robot's bark and bite are as bad as those of its live prototype, provided it is confronted by a burglar carrying a flashlight. When a ray of light enters the dog's lens-covered eyes, a photo-electric cell in its head converts the light into an electric current. This operates three relays, each controlling a small motor. The first sets in motion wheels that rush the dog toward the light, the second opens and shuts its jaws, and the third starts a phonographic reproduction of a ferocious bark.

The principle applied in the new watchdog's mechanism is the opposite of that used in the electric burglar alarm invented by Dr. Robert L. Burt, of the California Institute of Technology. This is set off when a ray from a concealed light, falling upon a photo-electric cell, is interrupted by the entrance of an intruder (P.S.M., Oct. '27, p. 51).

While the Parisian watchdog offers no resistance to a burglar without a flashlight, experts who saw it said one could be made that would bark in response to noises like footsteps or the creaking of doors or stairs, on the Televox principle (P.S.M., Dec. '28, p. 22).

New Window Glass Brings Sunlight to Dark Rooms

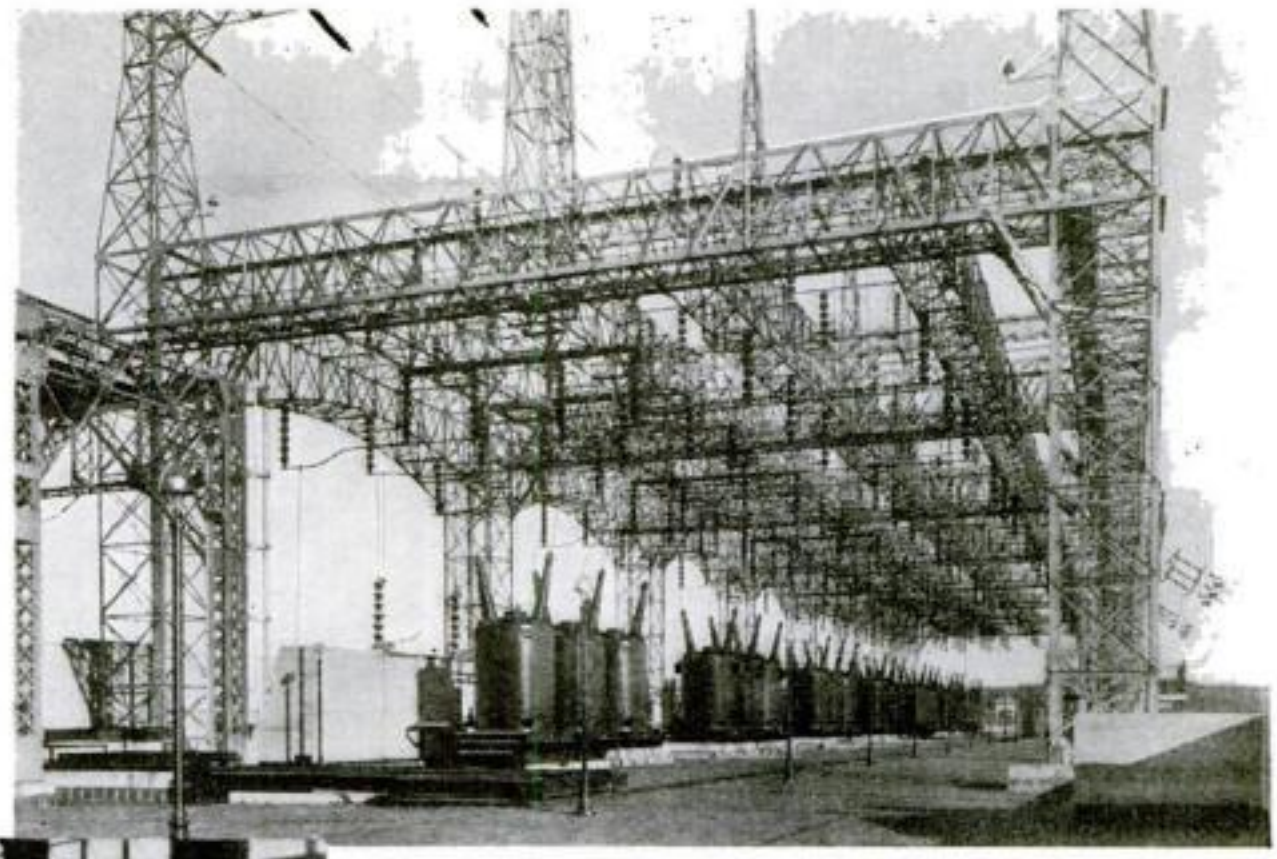
AN IMPROVED type of prismatic window glass has recently been placed on the market in London, England. Its purpose is to bring more light to those dwelling on the lower floors of skyscrapers or in near-by small buildings that are screened from the sun.

Prism window glass has been used before to deflect the course of light between tall buildings from a vertical to a horizontal path so that the light could better penetrate room interiors. It is claimed for the new glass that it will permit the passage of approximately twenty-two percent more light than the old panes. It does this because the prismatic design of its surface shifts the path of light from the vertical to the horizontal by some twenty degrees more than the old glass did. The large prisms of the new glass admit of easy cleaning, and their bottom faces are curved to ensure wide diffusion of rays.

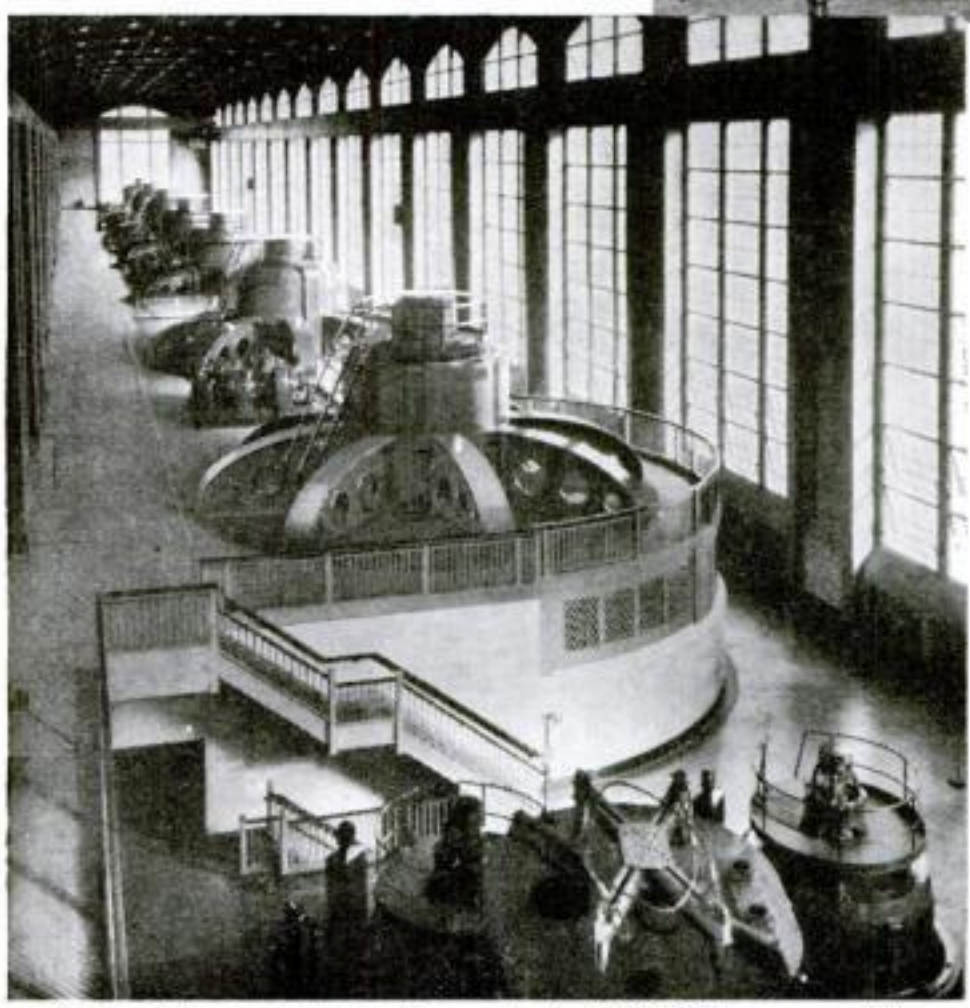
A Hydro Plant That Rivals Niagara Falls

ALREADY the second largest hydro-electric power plant in the world, with 350,000 horsepower, the giant Conowingo electric development on the Susquehanna River, Maryland, will, when additional machinery is installed, eclipse even Niagara, now the largest.

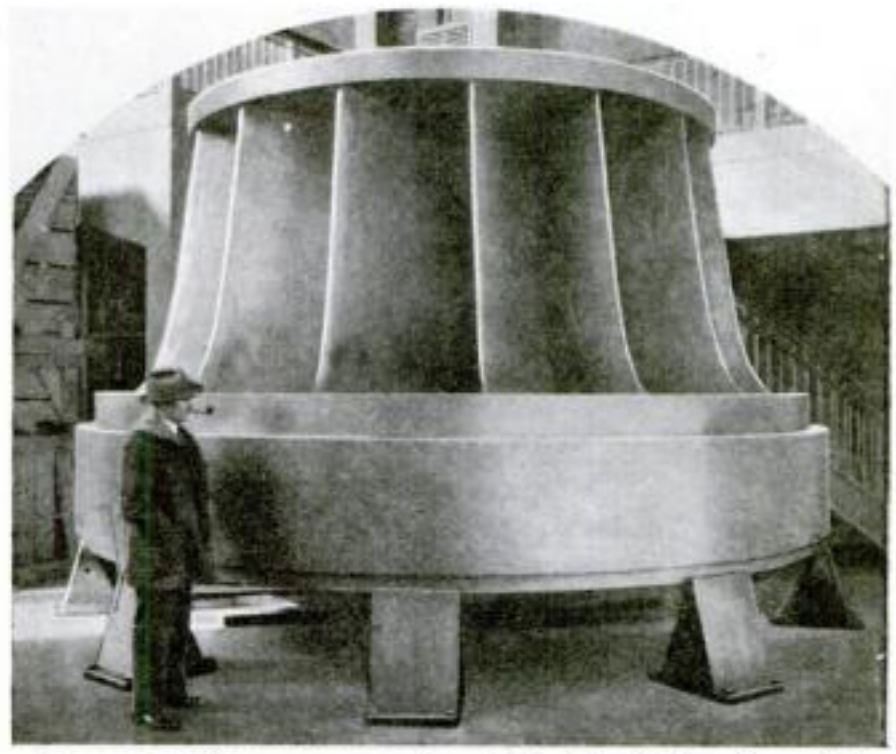
From the humming dynamos of this plant, electricity under the terrific pressure of 220,000 volts courses along transmission lines. Engineers expect that this center of energy will be an important link in future super-power hook-ups.



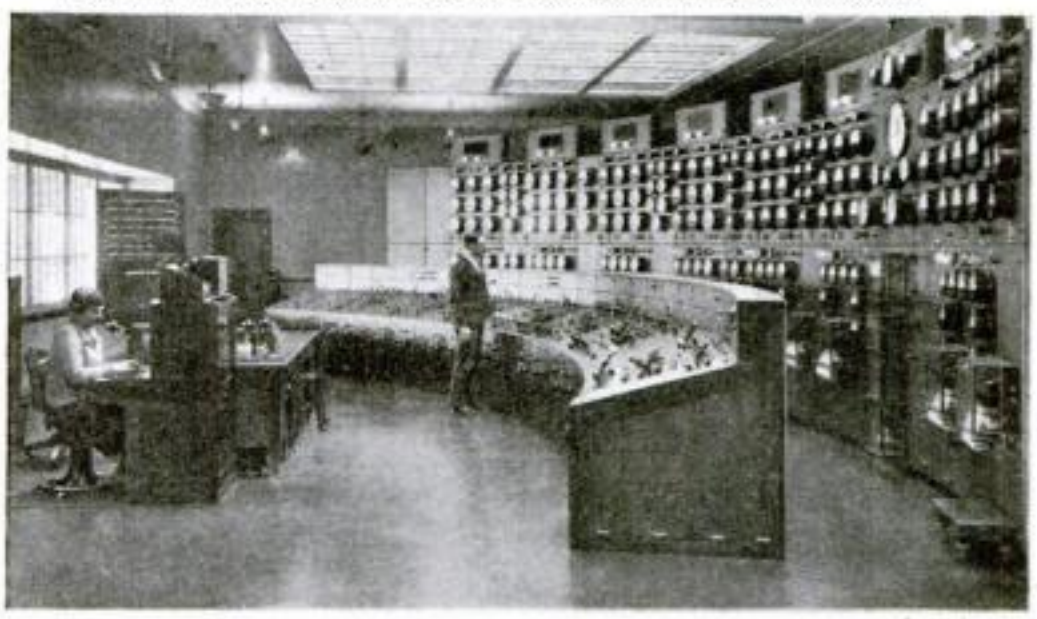
The substation at Conowingo contains the largest circuit-breaking switches ever manufactured. Each of the units weighs 165,000 pounds. This huge installation is located atop the roof of the power plant.



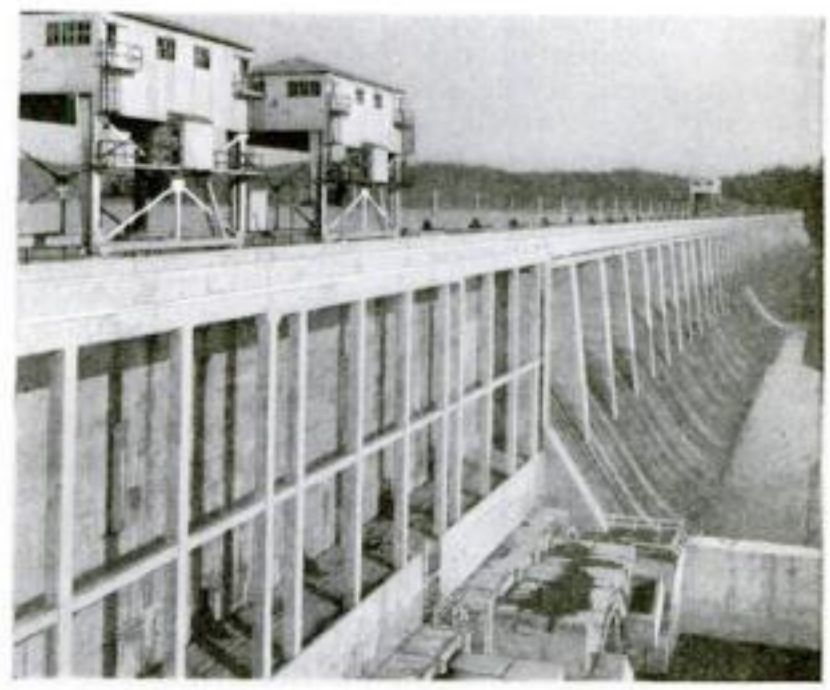
A row of huge generators with an output of 350,000 horsepower. The water turbine wheels are on the lower ends of the shafts beneath the generators. It is the second largest single hydro-electric plant in the world and will take first place when additions now contemplated are added.



A spare turbine runner or water wheel. One of them is used to drive each of the seven generators shown in the illustration at left. Comparison with the man gives some idea of the size of the wheel.



Conowingo's nerve center, the operating room, where hundreds of meters and switches permit one man to control the enormous flow of electric current.



Looking across Conowingo Dam where the Susquehanna River is harnessed—a link in future super-power hook-ups.

PROGRESS AND DISCOVERY

Elevated Highways to Speed Traffic

New York's auto highway, raised above the street on steel girders, will relieve traffic congestion.

As the end of the elevated railway in large cities draws near, the elevated highway is ushered in. An extensive boulevard raised on steel girders, which has been in prospect for several years, is now in the actual process of construction in New York City. The highway will stretch from the Battery, the extreme southern tip of Manhattan, northward along the west side to Riverside Drive, which begins at Seventy-second Street. The purpose of this elevated roadway along the Hudson River is to provide for speedy traffic out of the downtown section by avoiding the congested streets.

Film Developed for Movie Finds Carbon in Sun

Seldom, indeed, do movie producers aid astronomers, but Hollywood's demand for a film that would make day seem night resulted in spectrum photographs at the Mt. Wilson Observatory definitely confirming the presence of carbon in the sun. The story of this astronomical find was recently told at the Carnegie Institution, in Washington, by Harold D. Babcock, scientist of the observatory. Movie producers sought a way to photograph night scenes by day so as to avoid the expense of powerful lighting required for night photography out of doors. Since photographs made by infra-red light give a black sky, they sought a film to take movies by the infra-red rays in sunlight. To meet this need, Eastman Kodak chemists found that films or plates bathed in a solution of neocyanin acquire sensitivity to infra-red light.

Right here the astronomers stepped in, and took advantage of the discovery. They used the new plates for deeper examination of the spectrum, the scale of rays that make up the white light of the sun. The neocyanin plates not only made possible an extended study of the infra-red part of the spectrum, but furnished proof of the presence of carbon in the sun's atomic make-up, Babcock explained. The few weak lines of carbon showing on ordinary plates were clearly recorded on the infra-red sensitive plates.

"Sunflower on a Tripod" Helps Tunnel Surveyors

Surveyors who work below ground on tunnel construction jobs employ an instrument called the "sunflower mounted on a tripod." Its purpose is to take measurements from which engineers may compute the further need of blasting. An adjustable rod projects from the hub of a small wheel mounted on a tripod placed in the center of the tunnel circle. This rod takes the radius of the tunnel at various points around its circumference. When these radius measurements are charted on a piece of engineer's cross-lined paper, the completed figure resembles a sunflower, whence the name of the instrument. The measurements give the diameter of the tunnel from all angles, revealing any irregularities in the rock wall which must be blasted away to prevent encroachment on the cast-iron rings making up the shell of the tunnel. The "sunflower" little resembles its telescopic cousin used above ground, but it is just as much of a necessity to the surveyor.

This instrument was used recently in connection with the building of a tunnel sixty feet under the East River, New York, to connect Fulton Street, Manhattan, with Cranberry Street, Brooklyn.

New Test Shows Spinach May Contain Vitamin A

Spinach may be a storehouse of vitamin A, according to tests by spectroscopy, one of the newest branches of physical science. So Professors J. W. Woodrow and H. L. Cunningham, of Iowa State College, reported to a recent meeting of the American Physical Society in Chicago. For the purpose of analysis, the spinach was examined in a liquid form before the spectroscope. This instrument is used in studying the bands of colored rays formed by the passage of white light through a prism. Placed in front of the prism, the spinach juice was found to absorb certain definite rays of light from the spectrum. This is believed to indicate the presence of vitamin A. This is the first instance of detection of a vitamin by spectroanalysis. Previously such tests were made by noting the effects of food upon rats and other animals.

Bricks Twenty Feet Long Made by New Process

Bricks so large that several of them would wall a small bungalow may soon be manufactured commercially. It is claimed that a new process developed by Professors J. P. Shaw and M. C. Shaw, of the Pennsylvania State College's ceramics department, will produce blocks twenty feet long, five feet wide, and six to eight inches thick. Standard building and paving bricks both measure eight inches in their longest dimension.

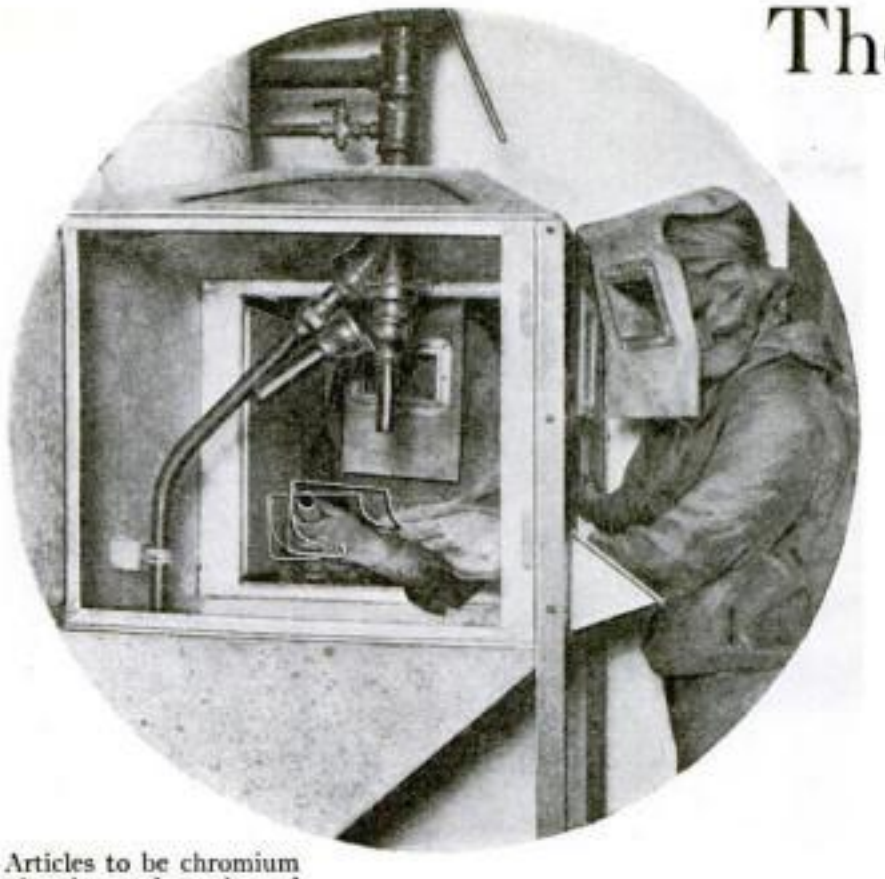
The object of the experiments was to find a new road building material. According to the discoverers, the huge bricks will provide roads harder than concrete, cheaper than macadam, and faster to lay than either. The bricks will be red or buff in color, and will weigh 100 pounds to the cubic foot—a little lighter than average. The surface of small models made so far in the laboratory resembles paving brick.

Electricity in the Air May Depress or Exhilarate

Why do people feel exhilarated one day and depressed another without apparent cause? It may be due to a difference in the amount of electricity they breathe. Evidence relating to the altering amount of electrified particles in the atmosphere was recently presented to a meeting of the American Physical Society by Professor Joseph G. Brown, physicist at Stanford University, Calif. His tests proved that the amount of loose electricity, or in other words charged particles of air, in each cubic foot is affected by rainstorms, winds, hot and cold waves, and similar changes in weather. Another peculiarity which he observed is that in air currents that are rising or falling, the change in the amount of electricity in the air varies rapidly.

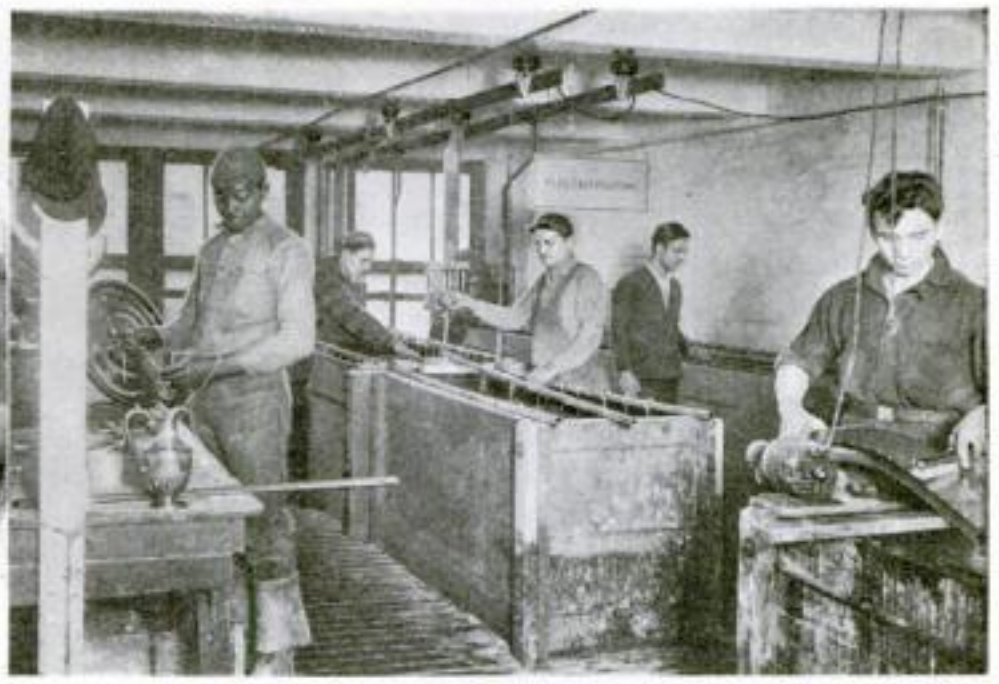
The Art of Chromium Plating Shown, Step by Step, in Pictures

AUTOMOBILE fittings, bathroom and soda fountain fixtures, tools, surgical instruments, and even pieces of modernistic metal furniture gleam these days with the brilliant, bluish-white finish of chromium plate, since the discovery of a way to plate this metal by electricity over other metals. Its surface may be made so hard that only corundum or the diamond will scratch it. Chromium plating is said to resist rust, to withstand heat, weather, and abrasion, and to keep its luster indefinitely. The photographs show the most important of the operations. First the article is "stripped," or cleaned, by sandblasting or acid treatment. Then it is successively nickel-plated, copper-plated, replated with nickel, and finally chromium-plated. The object of the platings with copper and nickel is to secure a smooth, even coat of chromium. After each plating the article is polished.



Articles to be chromium plated are first cleaned down to the raw metal by a blast of sand. Nozzles are seen through the open door. Notice the heavy gloves protecting the workman's hands.

After sandblasting, and a thorough polishing, the article first gets a coat of nickel plate—the basic coat on which several others will be applied. Photo shows a plater removing a sword from nickel bath.

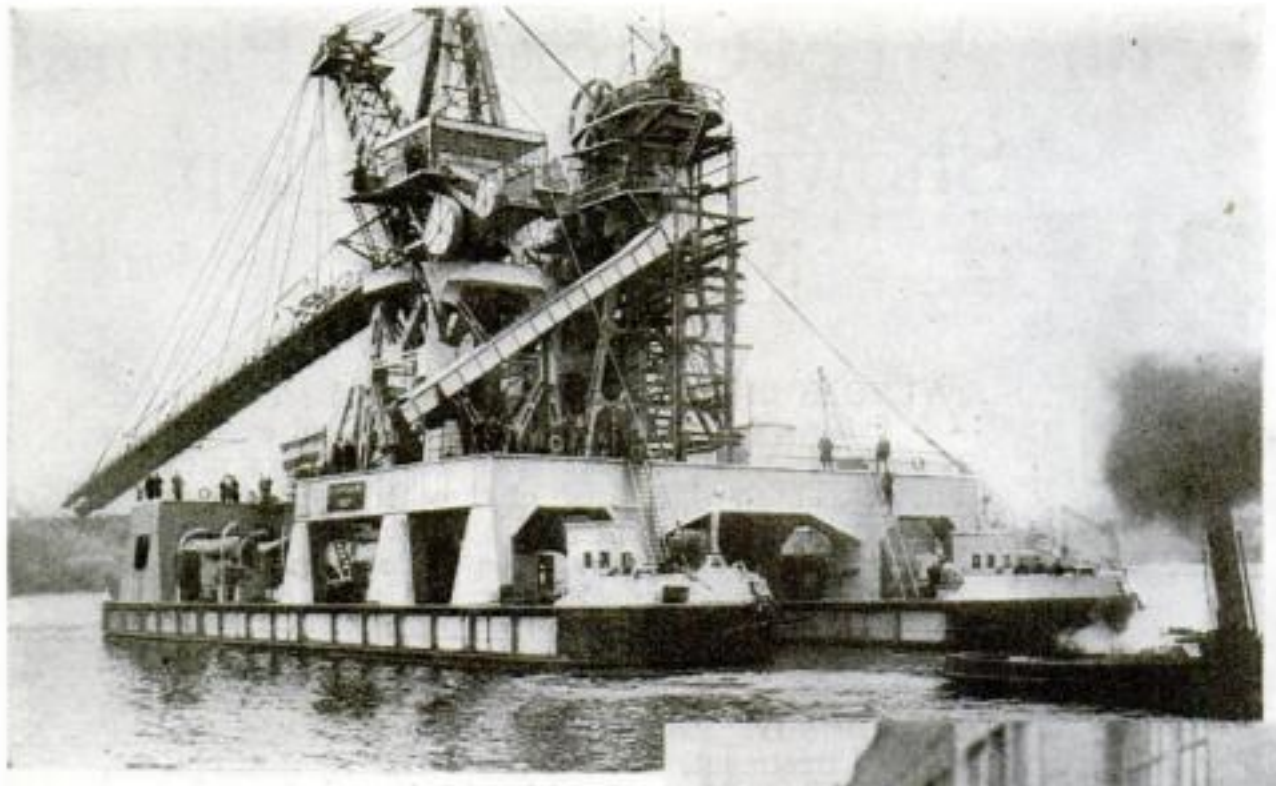


The copper-plating room where, after another polishing, articles are given a bath of copper over the nickel. This is followed by still another polishing and a second coat of nickel. Successive coats of different metals applied in this way insure that the final coat, of chromium, will be smooth. The number of steps required in this rather complicated process is offset by the beauty, durability, and resistance to tarnish of the finished coating.

This auto radiator shell was chromium plated in an 18-foot tank holding 1,360 gallons. Man at left controls rate of plating by regulating the current. At right, a blower carries off the fumes of the plating bath.

A group of men at work on the polishing machines. Articles are polished after each plating, four times in all, to insure perfectly smooth finish. Note the various types of polishing wheels at extreme right of picture.

PROGRESS AND DISCOVERY



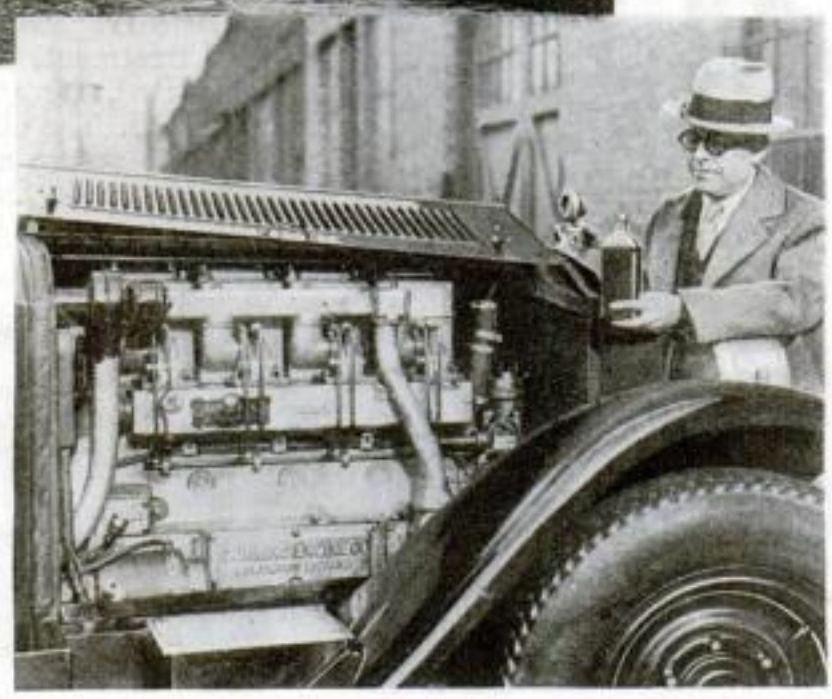
Rouen Gets World's Biggest Dredge from Germany

RESEMBLING a squat battleship with giant conning towers and a tunnel boring through its middle, the world's largest dredge has been constructed at Lübeck, Germany, for use in the French port of Rouen. Weighing 2,100 tons and costing $625,000, it has forty-seven shovels, each capable of holding seventeen and a half cubic feet of dredged matter. Powered by its 1,040-horsepower engines, in sixty minutes it can dredge up enough material to bury a forty foot wide pavement a city block long under a layer of harbor debris two feet deep. From the port of Lübeck, where the dredge was built, forty miles north of Hamburg, Germany, to the harbor of Rouen where it will be put to use, is a long haul for the pygmy tugboats that must take it there.

Picture Sent 22,000 Miles Through Air by Radio

THE picture of a rectangular design painted in black on a white card recently traveled 22,000 miles through the ether. It went to Australia and back again, in a test at the General Electric Company's television broadcasting station at Schenectady, N. Y. About one eighth of a second elapsed between the time when the image was broadcast at Schenectady and its reappearance on a screen before observers, after its return journey from the Australian radio station that received and rebroadcast it. The image was, at times, distinct enough so that the rectangle could be recognized.

This is believed a distance record for any television attempt. It was hailed by Dr. E. F. W. Alexanderson, General Electric television expert, as an indication that the problems of sending moving scenes by radio over great distances might be solved if practical television over short distances ever arrives. "There are ripples in the ether such as there might be in a pail of water," he said, "and I did not believe the picture would be distinct enough even to tell what it was."



Gallon of Oil Runs Diesel Powered Auto 26 Miles

SEVEN hundred and ninety-two miles on thirty gallons of fuel at a cost of a dollar and thirty cents, an average of twenty-six miles per gallon, is the recent record of a New York City man driving a car powered with a Diesel engine. The principal feature of the Diesel engine, long used in heavy marine service, is that it burns oil. Having no spark plugs, the engine works by the explosion of oil vapor within its cylinders, the pistons compressing the vapor until the heat induced by the pressure ignites it. Diesel engines, in spite of the fact that they use fuel obtainable at a little over four cents a gallon, have so far failed to demonstrate the flexibility of the ordinary gasoline motor. Hence they have not entered into general use for automobiles.

New, Big-Yielding Corn Matures in 100 Days

BY CROSSING two corn families at the Connecticut Agricultural Experiment Station, Dr. Donald F. Jones has produced a new variety of this important native grain of the western continent.

It is claimed that the new corn, called "Canada Leaming," will survive early frost, will mature within 100 to 110 days, and will give a bigger commercial yield. The six reigning types of corn—pod, pop, flint, dent, flour, and sugar—vary from one to seven months in their time demands for maturing. Corn is invaluable as a food stuff in the raising of hogs, cattle, and sheep for market—one of the country's greatest industries. Hence the importance of this new, early maturing variety of this vegetable.

Earth's Heat Is Not Great 30 Miles below Surface

THIRTY miles below the surface of the earth it is not much warmer than at the surface. That is the surprising conclusion of two French electrical experimenters, Conrad and Marcel Schlumberger, recently reported to the American Institute of Mining and Metallurgical Engineers. Previously it had been supposed that the further the earth was penetrated, the hotter it would be found, and that near the center it had a fiery core of molten material—a view given some support by temperatures encountered in deep mine shafts. The temperature rises, in various parts of the world, from about one degree to four degrees for every 100 feet of descent from the surface. Earth heat even prostrated workmen building a railroad tunnel through the snowy Alps.

The Frenchmen, already known as inventors of a system for prospecting with electricity, were of course unable actually to measure the temperature directly at any such depth as thirty miles. But they devised an ingenious system of finding it indirectly. Electric currents were sent through the earth at great depths, between two electric contacts on the surface, and the resistance encountered by the current measured and used to compute probable temperature. Other magnetic studies recently suggested the Pacific Ocean side of the earth the hottest internally.

Dr. D. F. Jones with fast-growing corn he developed at the Connecticut Agricultural Station.

World-Wide Events in Aviation

The "flying wing," in a California test, made more than 100 miles an hour.

This new batlike plane has no struts, fuselage, or braces to catch the wind. It is a pusher type, seats two, and has a 30-foot wing spread. Its inventors say it will revolutionize plane design.

Batlike Airplane Will Carry Load in Wing

FORERUNNER of giant ships housing passengers and fuel within the wings, unlike any so far built, a batlike airplane recently soared over Burbank, Calif. It pleased its designers by attaining a speed well over a hundred miles an hour, according to reports.

The experimental machine, seating two people, was designed by W. K. Jay and John K. Northrup, also the designers of the fast Lockheed commercial monoplanes. It is of radical design, intended to cut wind resistance to a minimum. Behind the single wing, two spindlelike outriggers support the tail with its two disk-shaped surfaces. A pusher propeller, instead of the usual tractor type, drives the craft, which has a wing spread of thirty feet and a motor of seventy horsepower.

Future and larger airliners patterned after this ship, the inventors say, may inaugurate national passenger lines with 160-mile-an-hour cruising speed, and mail and express lines of 200-mile speed. The passenger planes would seat twelve, in rows of four abreast.

Graf Zeppelin, in 50 Trips, Flies 72,000 Miles

THE *Graf Zeppelin*, Germany's greatest airship, has made fifty trips to date, and has burned up more than eight million cubic feet of fuel gas. It has carried 820,000 pieces of mail and more than thirty-five tons of provisions. These and other facts are reported in the ship's log, recently made public by the German Zeppelin company.

In all, the craft has carried 1,574 persons besides the crew, an average of thirty-one on each trip. It has crossed the Atlantic five times. Notable flights besides the round-the-world voyage last fall and previous ocean flights have been a 4,975-mile cruise over Palestine and back and a 2,956-mile jaunt through the Balkans. In all, the ship has traveled more than 72,000 miles through the air, averaging approximately 1,440 miles on each cruise.

The *Graf Zeppelin* is now expected to visit the United States, by way of Brazil, sometime in May. A proposed expedition for exploration purposes to the Arctic, scheduled for this spring, has been cancelled because of difficulty in obtaining insurance for the aircraft.

Government Gives Michigan Airport Highest Rating

THE first "A-1-A" rating for airports, highest issued under Government regulations, has just been awarded to the municipal landing field at Pontiac, Mich. It is also the first of a series of ratings of hundreds of airports awarded by United States Department of Commerce officials after a program of inspections undertaken early last year.

Such ratings provide valuable information to pilots visiting unfamiliar territory. The first "A" in the highest rating indicates that certain minimum standards of hangar space and general facilities have been met. The numeral "1" shows the port to have at least 2,500 feet of effective landing area in all directions, or four wide landing strips of this length. Night lighting is shown to be good by the final "A" in the rating.

This Menasco motor, with upside-down cylinders, develops 70 H.P. in the "flying wing."

New Plane Resembles a Powered Glider

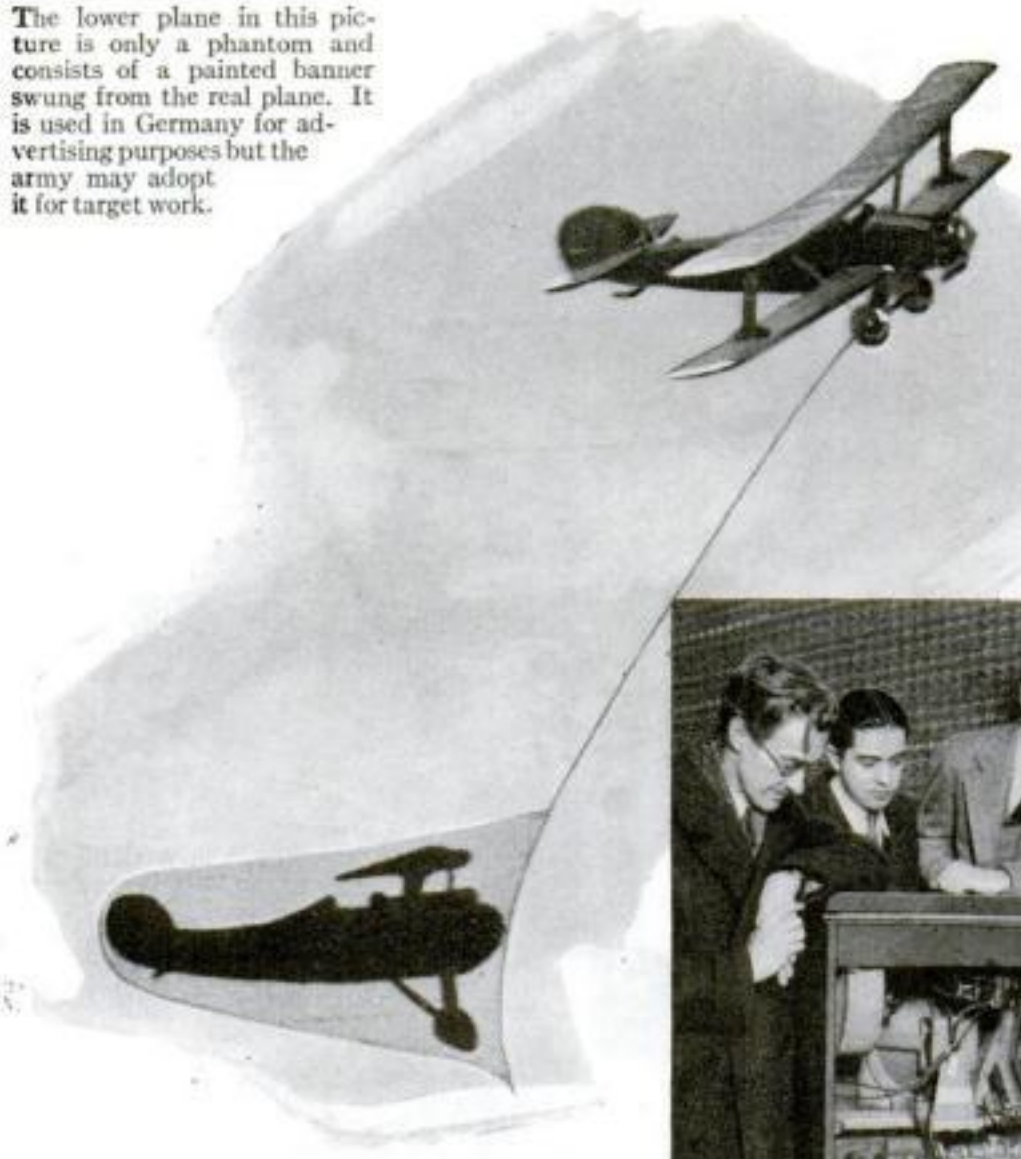
MORE like a glider than an airplane is a new light machine recently placed on the market. Its two-cylinder engine is claimed to burn less than two gallons of gasoline an hour, although it develops thirty horsepower. Great economy in running results.

Also, the lightness of the craft enables it to glide long distances to a landing in case of motor trouble. The novel machine sells for $1,880. Recent tests at St. Louis, Mo., are reported to have demonstrated its quick take-off and the ease with which it can be flown.

Autogiro from England Has Roomy Cabin

LATEST styles in autogiros, or "windmill planes," are exemplified in a new machine recently imported from England by the Pitcairn aviation firm, of Philadelphia, which has undertaken the construction of the planes in this country.

The newcomer, unlike its open pred-



The lower plane in this picture is only a phantom and consists of a painted banner swung from the real plane. It is used in Germany for advertising purposes but the army may adopt it for target work.

ecessors, is a cabin craft. The roomy interior of the duralumin fuselage affords space for three passengers besides the pilot. A geared Wright motor drives the machine. The landing gear is fitted with "air wheels," a new type of balloon tire.

The freely-revolving "windmill" of four horizontal blades enables them to land or to take off in an extremely short space. In tests autogiros have flown at more than 110 miles an hour, and have climbed to 12,000 feet.

Light Airplane Sets a New Altitude Record

A NEW world's altitude record for light airplanes was made when Barney Zimmerly, Marshall, Mo., pilot, recently flew his low-wing, open cockpit "flivver" plane to a height slightly more than five miles over St. Louis, Mo. Although his barographs awaited official checking, they indicated that he had probably reached an altitude between 27,000 and 28,000 feet, far surpassing the previous German record of 22,500 feet. The term "light plane" as it applies to this record means planes of not more than 800 pounds' weight, and includes the small private and sport craft that have recently become popular in this country.

To sustain life in the thin upper air, Zimmerly carried two bottles of oxygen.

Officials who watched the two-hour flight emphasized the fact that Zimmerly used a standard commercial machine of approved type rather than an experimental design. The tiny Barling craft weighs only 735 pounds, carries a useful or "pay" load of 340 pounds.

Model shows how electric cables laid on the ground outside airports may be used to aid flyers lost in a fog and searching for a hangar. Two loops of copper cables extend out from the airport, from one of which dots are flashed and from the other dashes. These signals, detected by the aviator, are uninterrupted while he flies a true course. A break shows he is off the line. Tests made on this model proved satisfactory.

Strange Events of Aviation

A CHRONICLE of recent strange events in aviation would record the following:

Levee guards near Greenwood, Miss., received orders to "shoot down airplanes," occasioned by fear of aerial bombing of dikes that checked flood waters.

A Moorestown, N. J., broker clung for his life to the tail of a plane while the pilot, unaware he was there, flew eight miles. The involuntary passenger had helped hold back the starting plane, and failed to let go in time. He was unhurt. It was aviation's second incident of the kind.

The Luke Field, Hawaii, pilot who forgets most often to put out the wheels of his folding landing gear when bringing down an amphibian plane on dry land, will win a loving cup, made of wood, donated by the commanding officer. So far six absent-minded pilots, none of whom has been injured, have qualified for this doubtful honor.

The first sea rescue involving an airship was the feat of the commercial blimp *Vigilant*, which reported to Coast Guardsmen a man and woman adrift off Tampa, Fla., in an open boat. A patrol boat rescued them.

Electric Flasher Is Used to Signal Plane in Fog

A CHANCE remark by Col. Charles A. Lindbergh when he visited their research laboratory last summer, General Electric officials announce, has resulted in a new ground signal for aviators. Lindbergh's observation was that "flashings made by the poles of trolley cars are noticeable when flying in a thick fog, even though other lights cannot be seen." Dr. Irving Langmuir, assistant director of the laboratory, followed the suggestion and produced a new type of electric flasher, giving code signals so that it could not be mistaken for a trolley pole.

Other devices in current use for signaling aviators from the ground show a wealth of variety, a recent Government survey revealed. Some airports use colored flags; three western landing fields employ steel panels, red on one side and white on the other, to signal pilots.

For night signaling, lights from a Very pistol and red and green lights on the wind indicator are among the methods used.

And this is called a safety device! Flying over Florida, James Terry demonstrates his contrivance for crawling to the tail of an airplane in mid-air and making repairs.

Sugar *from* Sunflowers

Jerusalem artichoke tubers from which sugar is extracted.

Government Experts Find Cheap Method of Producing "Levulose"

By ROBERT E. MARTIN

NEARING completion at Washington, D. C., is one of the most remarkable sugar factories in the world. It will produce three fourths of a ton, each day, of a new kind of sugar called the finest in the world—sweeter by far than the best table sugar, at least its equal in food value and healthier, because it is the kind Nature meant man to eat. The raw material from which this strange sugar is obtained is a species of sunflower, best known as the Jerusalem artichoke.

The new factory is an experimental one being built by the United States Bureau of Standards, Frederick J. Bates, Chief of the Sugar Section, told POPULAR SCIENCE MONTHLY. For two seasons it has operated a much smaller one by the same process. From the plant now being built the experts of the Bureau of Standards hope to gather enough data to design a commercial factory.

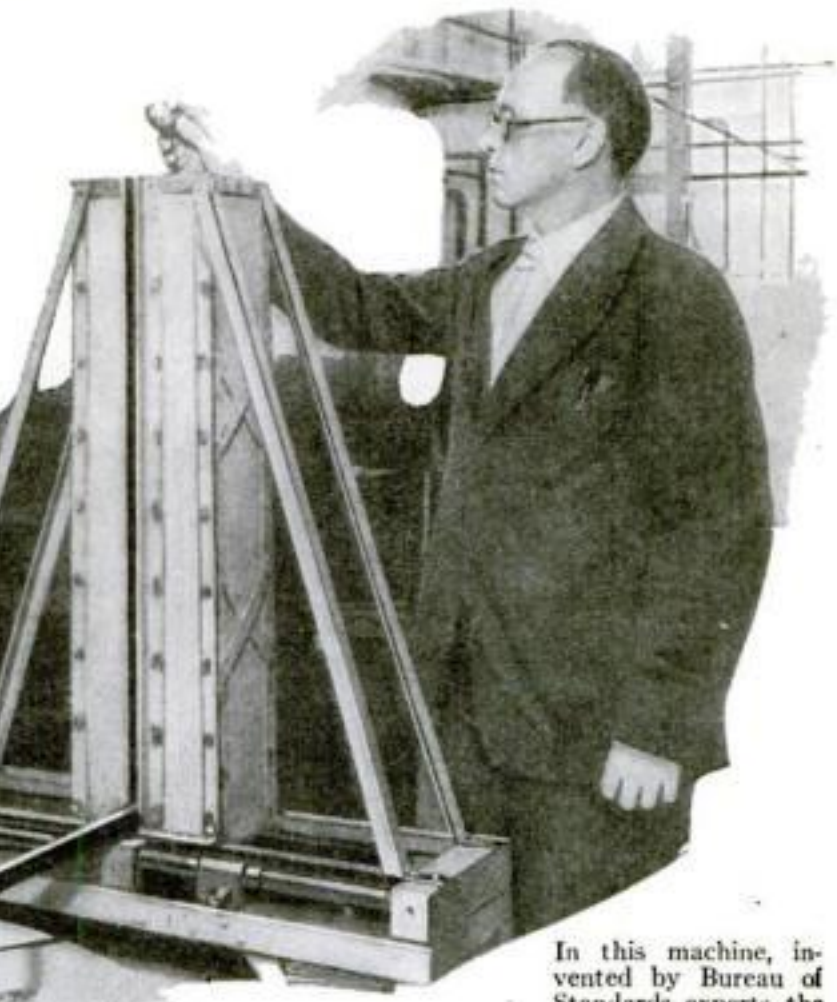
There are various kinds of sugar, one of which, fruit sugar, is the sweet substance in most ripe fruits and in honey. It is also known to chemists as "levulose."

Its pure, white crystals, indistinguishable from ordinary granulated sugar in appearance, are from fifty to seventy-five percent sweeter. A man who takes a lump and a half of sugar in his coffee would be satisfied with a single lump of fruit sugar, or levulose. It is the most easily digested kind, and Bates calls it "the finest of all sugars." Another Bureau of Standards expert, Dr. Paul Heyl, declares it the natural sugar man was designed to eat. It was in use, he says, up to the time of Columbus, when cheaper cane sugar crowded it out. Only its expense has prohibited its manufacture today.

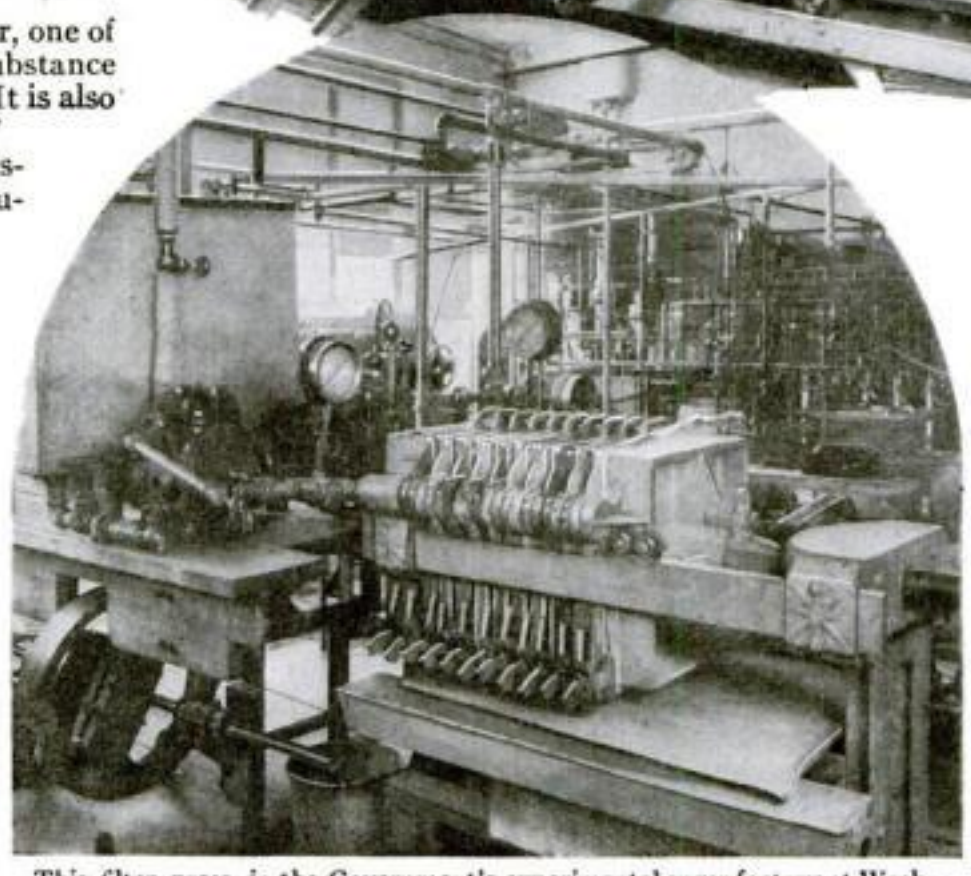
If this little-known sugar could be produced at a cost that would compare with cane sugar, it would undoubtedly appear at once on American tables. Whatever plant it could be made from would be a profitable new crop for American farmers. For these reasons the Bureau of Standards set its expert chemists upon the trail of plants that might be sources of levulose—then selling to rich diabetics who could not eat ordinary sugar, at from $30 to $110 a pound.

They found the sugar, in a strange assortment of plants—the Jerusalem artichoke, the dahlia, and such hardy weeds as the chicory, burdock, goldenrod, and dandelion. Of these the Jerusalem artichoke was the most promising. When specimens were analyzed in the laboratory, more than two thirds of the solid matter dissolved in the juices often turned out to be levulose.

The discovery gave this misnamed plant new interest. It is not an artichoke at all, but a sunflower. It is only a distant relative of the true, or globe, artichoke commonly used for food. Nor has it anything to do with Jerusalem. It is of American origin, but the name "Jerusalem artichoke" is probably a corruption of the Italian name for the plant, *girasole articiocco*, which means sunflower artichoke. Tubers that form its root are the edible part, while that of the true artichoke is the cluster of fleshy leaves at the base of its flower.



In this machine, invented by Bureau of Standards experts, the sunflower tubers are sliced as the first step in the process of getting out their levulose.



This filter press, in the Government's experimental sugar factory at Washington, D. C., is a part of the Bureau's quantity production equipment.

Indians of the upper Mississippi Valley and the East first cultivated the so-called Jerusalem artichoke for food. An "artichoke chip," resembling a potato chip, is manufactured from it today, though it is mainly cultivated as a livestock food. This is the odd plant in which the Bureau of Standards found a sugar which, in its own opinion, may largely replace the world's entire sugar supply.

(*Continued on page 150*)

Do Beavers Rule on Mars?

No trace of human intelligence has been found on the red planet, and it is thought that evolution, through lack of the stress that helped on earth, may have halted with some animal adapted to a land and water life.

By THOMAS ELWAY

MARS is so like the earth that men might live there. It has air, water, vegetation, a twenty-four-hour succession of day and night, and daily temperatures no hotter and nights not much colder than are known on earth. But because Mars has no mountain ranges and probably never had an Ice Age, it is considered highly improbable that it is inhabited by manlike creatures or by any that possess what men call intelligence. The evolution of life on Mars must have been different from that on earth.

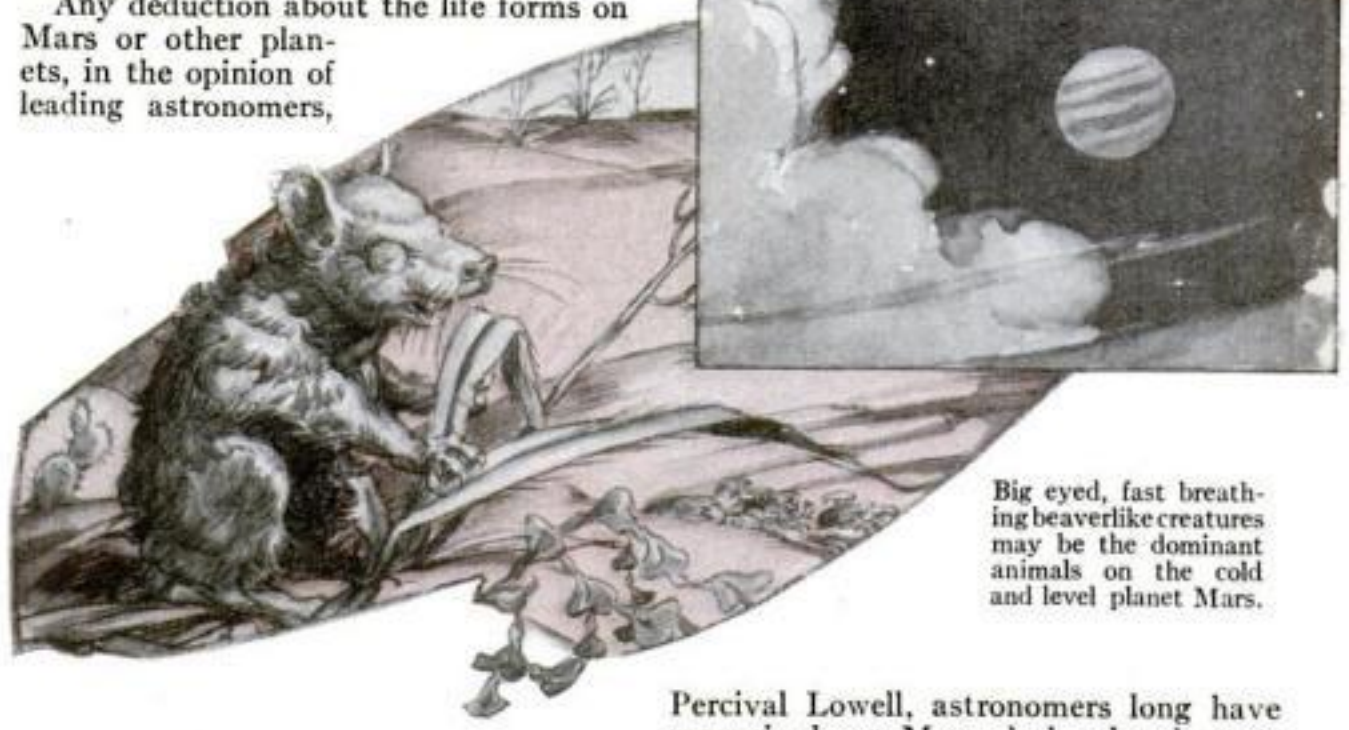
One of the best signs of intelligence on Mars, Dr. Clyde Fisher, of the American Museum of Natural History, New York City, said recently, would be some indication of artificial light on the planet. Undoubtedly, lighted cities on Mars could be seen through the telescopes now in use.

However, there is one condition that prevents satisfactory and conclusive observation. When Mars is closest to the earth, both planets are on the same side of the sun. Then only the sunlit side of Mars is seen. To see any part of the night side of Mars, observation must be made when it is part way around in its orbit toward the far side of the sun, so that a slice of both the dark and the lighted sides can be seen.

When even a part of the night side is visible, Mars is relatively far away and difficult to see clearly. The Martians, if there are any, would not have equal difficulty in observing the dark side of the earth, for when the two planets are nearest to each other, the earth is showing Mars its dark side.

THESE consequences of the orbits in which the two planets move might make it difficult for the dim glow of lighted Martian villages, were any such in existence, to be detected from the earth. Cities as bright as New York or Paris, on the other hand, undoubtedly would be visible. With the new 200-inch telescope which, it is planned, will be erected in California, it surely would be possible, Dr. Fisher predicted, to distinguish such brightly lighted cities, if any such Martian centers of civilization exist. If such artificial lights are never seen, he added, it might go a long way toward proving that Mars does not possess intelligent life. Other students of the subject, however, say it is possible that Martian civilization may correspond to that of an earlier, pre-artificial light era on earth. In any case, astronomers agree that there is a practical certainty that Mars possesses kinds of life below human intelligence.

Any deduction about the life forms on Mars or other planets, in the opinion of leading astronomers, must start, if it is to be at all reasonable, with the idea of the distinguished Swedish scientist, Dr. Svante Arrhenius, of one kind of life-germ pervading the entire solar system. There is no reasonable way even to guess the form of this life-germ. It may, perhaps, have drifted, as tiny living spores, from planet to planet, whirled through space by the pressure of light.



Big eyed, fast breathing beaverlike creatures may be the dominant animals on the cold and level planet Mars.

Whatever its form, the life-germ, biologists assume, probably developed on Mars, much as it did on earth, in oceans which have evaporated in the course of ages. Early conditions on the two planets are supposed to have been very similar.

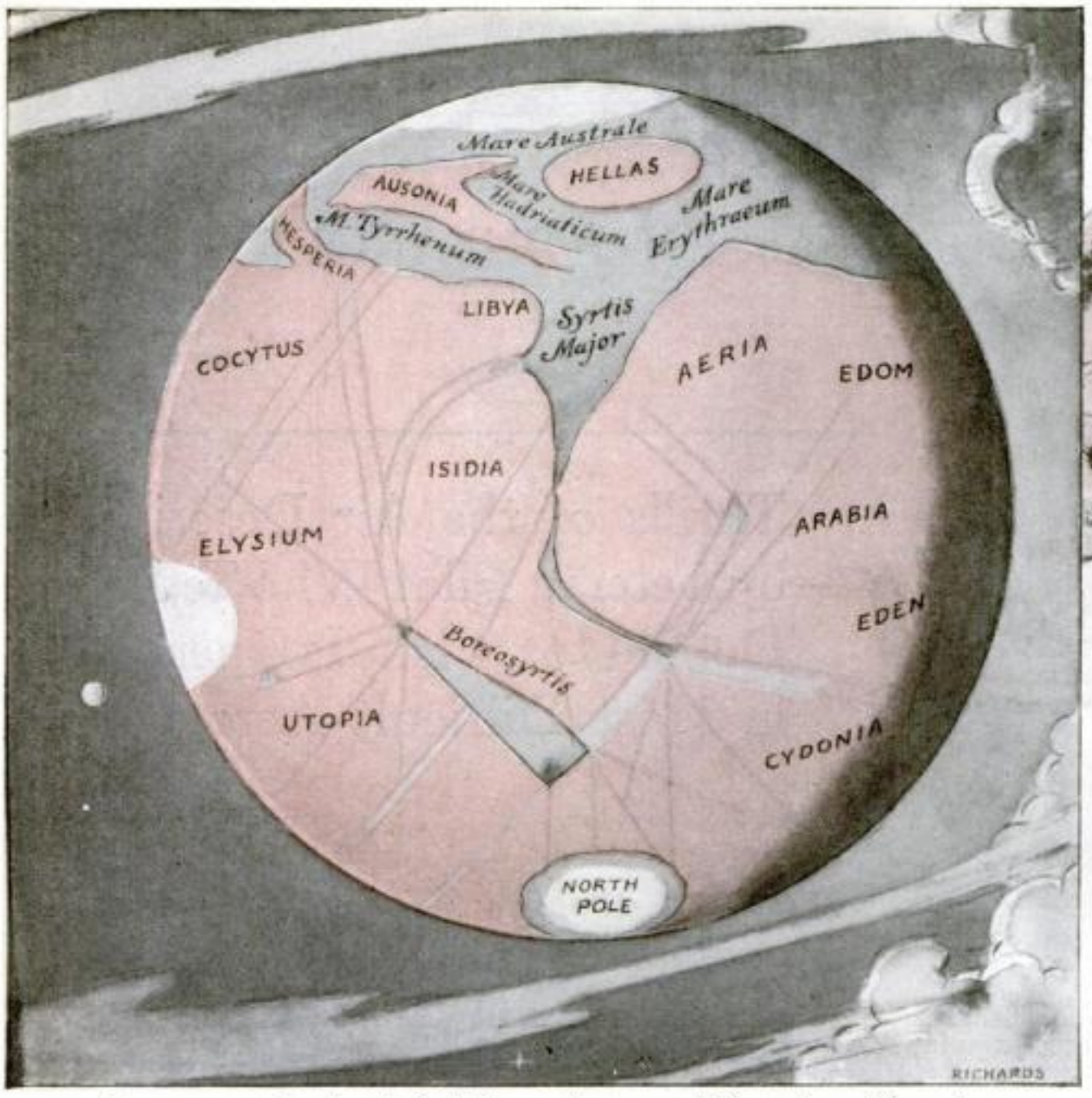
The theory that Martian life evolved along lines similar to those followed by evolution of life on earth is supported by at least one definite fact. Careful spectroscopic studies at Mt. Wilson Observatory, near Pasadena, Calif., and elsewhere have disclosed that gaseous oxygen exists in the Martian atmosphere. The presence of oxygen gas is highly significant, since the only known way in which any planet can obtain a supply of this gas is through the life activities of plants.

Following the lead of the great expert in Martian astronomy, the late Professor Percival Lowell, astronomers long have recognized on Mars dark-colored spots and markings which are believed to be plains or valleys covered with vegetation. The oxygen which spectroscopes show in the Martian air is taken as another proof that this vegetation exists.

Since the activity of plants is the only known process of cosmic chemistry by which free oxygen can be produced on the surface of a cooled planet, the presence of oxygen in the rarefied air of Mars indicates that vegetation there must have produced oxygen out of water and sunlight as it has done on earth. It is difficult to exaggerate the importance to Martian theorizing of the definite fact that Mars has oxygen and, therefore, vegetation.

A CERTAIN way along the path of evolution, Martian life shows evidence of having undergone a development like that on earth. What happened after that is a matter of deduction.

The known facts about Mars are the fruits of years of astronomical observation and study. The dark and light markings on its surface can be seen through a large telescope. The lighter ones are reddish or yellowish and usually are interpreted as being deserts. The darker areas are greenish or bluish in color and are universally ascribed to vegetation. Mars possesses



Astronomers, peering through giant telescopes, have mapped Mars and named its various features. Note the polar ice caps, which change with the coming of the winter or summer.

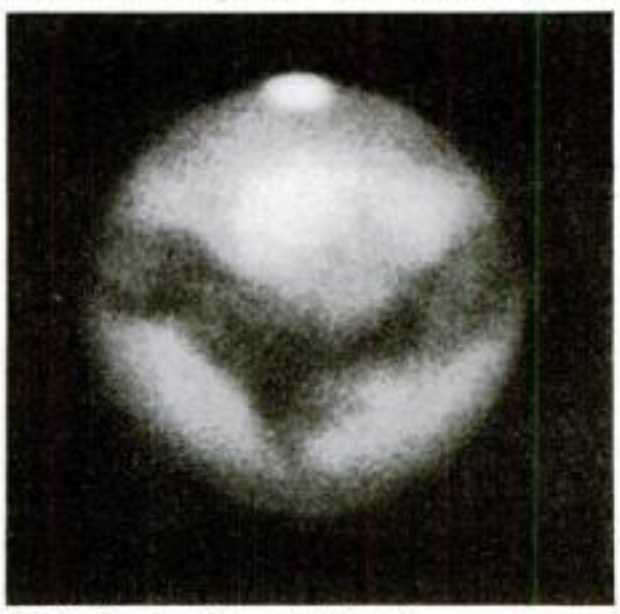
two white polar caps. Recent measurements of Martian temperatures by Dr. W. W. Coblentz and Dr. C. O. Lampland, at the Flagstaff Observatory, indicate that these are composed of snow and ice.

In the Martian autumn these caps increase and become whiter. In the planet's spring they shrink and often seem to be surrounded by wide rings of bluish or blackish material, which may be sheets of water or vegetation. Still more significant are the springtime changes in the planet's areas of supposed vegetation. Many of these darken in color. Others widen or lengthen. Often new dark areas appear where none had been visible during the Martian winter. Few astronomers now doubt that these dark areas represent some kind of vegetation.

SO FAR, everything runs strikingly parallel with evolution on earth. It is probable that it will be found to have run parallel farther still and that animal life on both planets, too, has been similar—for at least part of the evolutionary story. But during all the years of earnest and competent research not one clear sign of manlike life on Mars has been detected. Professor Lowell's famous Martian "canals," which for a long time were considered a probable sign of the intelligent direction of water, are now believed to be wide, shallow river valleys.

This lack of manlike life is precisely what a biologist would expect. Man and man's active mind are believed to be products of the Great Ice Age, for that time of stress and competition on earth is what is supposed to have turned mankind's anthropoid ancestors into men. The period of ice and cold over wide areas of the earth was caused, at least in part, by the elevation of continents and mountain ranges. On Mars, no mountain ranges exist, and it probably never had an Ice Age.

It is on these hypotheses that science bases its assumption that there is no human intelligence on Mars, and that animal life on the planet is still in the age of instinct. The thing to expect on Mars, then, is a fish life much like that on earth, the emergence of this fish life onto the land, and the evolution of these Martian land-fishes into reptilelike creatures. Finally, animals resembling the earth's present rodents like rats, squirrels, and



Scientists no longer believe there are man-made canals on Mars, and think the broad bands are the wide beds of wandering streams.

A Martian, fit to stand 100 degrees below zero, might well resemble this creature.

beavers would make their appearance.

The chief reason to expect this final change of Martian reptiles into primitive mammals lies in the fact that on earth this evolution seems to have been forced by changeable weather. And Mars now possesses seasonal changes like those on earth.

Pure biological reasoning makes it probable, therefore, that the evolution of warm-blooded animals may have occurred on Mars much as it did here. There seems no reason to believe that Martian life has gone farther than that. Mars is a relatively changeless planet. Biologists suppose that the rise and fall of mountains, the increase and decrease in volcanic activity, and the ebb and flow of climate forced life on earth along its upward path. Martian life of recent ages seems to have lacked these natural incentives to better things.

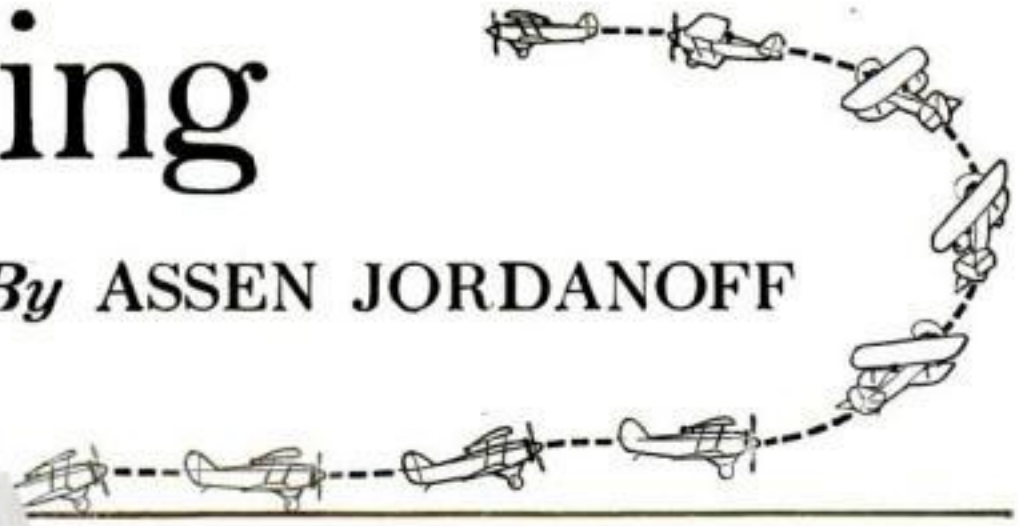
Now, there is one creature on earth for the development of whose counterpart the supposed Martian conditions would be ideal. That animal is the beaver. It is either land-living or water-living. It has a fur coat to protect it from the 100 degrees below zero of the Martian night.

THE Martian beavers, of course, would not be exactly like those on earth. That they would be furred and water-loving is probable. Their eyes might be larger than those of the earthly beaver because the sunlight is not so strong, and their bodies might be larger because of lesser Martian gravity. Competent digging tools certainly would be provided on their claws. The chests of these Martian beavers would be larger and their breathing far more active, as there is less oxygen in the air on Mars.

Such beaver-Martians are nothing more than pure speculation, but the idea is based upon the known facts that there is plenty of water on Mars; that vegetation almost certainly exists there; that Mars has no mountains and could scarcely have had an Ice Age; and that evidences of Martian life are not accompanied by signs of intelligence.

Herds of beaver-creatures are at least a more reasonable idea than the familiar fictional one of manlike Martians digging artificial water channels with vast machines or the still more fantastic notion of octopuslike Martians sufficiently intelligent to plan the conquest of the earth.

Stunt Flying



By ASSEN JORDANOFF

Thrills of the Air Described by Veteran Pilot Who Tells in Detail How Plane Is Operated in Most Difficult Aerobatics

Jordanoff shows a student how the controls are manipulated in the chandelle, a sharply banked turn on the take-off, illustrated in the diagram above. He calls this the most dangerous maneuver in flying.

A PILOT who can't stunt is a fair-weather flyer. He is unfit to leave an airport unless conditions are ideal. He is unprepared for the emergencies of the air. A dozen times in my seventeen years of flying the ability to stunt has saved my life.

Once, during the World War, I was limping home from the Saloniki front in a crippled Albatross. The 160-horsepower Mercedes had lost half its cylinders through sticking valves. It was popping and sneezing, getting weaker every mile. The ship was losing altitude. Below me, a river and a single-track railroad wound through a narrow gorge of the Balkan Mountains. The Albatross sank below the rim of this canyon. It dragged over a village, barely missing the roof tops. Then, before I could take advantage of it, the only available landing spot, a potato patch, slipped under my wings and was gone.

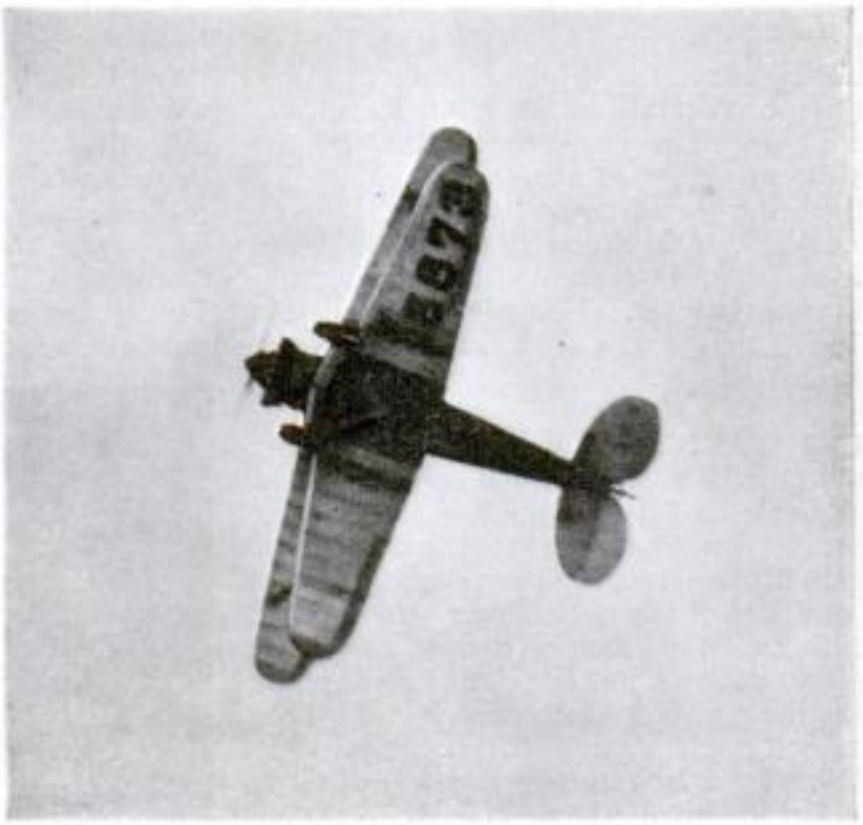
I was too low to turn back. Ahead, the gorge narrowed to a pass hardly wider than the span of the plane. The river ran foaming between the jutting walls. No plane could thread that needle's eye and live. The turbulent air would dash it against one of the rocky walls a few feet from its wing tips. Suddenly, a terrific gust, sweeping from the pass, struck the Albatross and carried it a hundred feet straight into the air. That was my one chance. Kicking over the rudder, I plunged into the tightest corkscrew dive I ever made. I can still see a gnarled tree, standing between the river and the railroad, flash past my banked wings as I missed it by inches. This diving turn pointed the ship back down the valley and the momentum carried me to a safe landing at the potato patch.

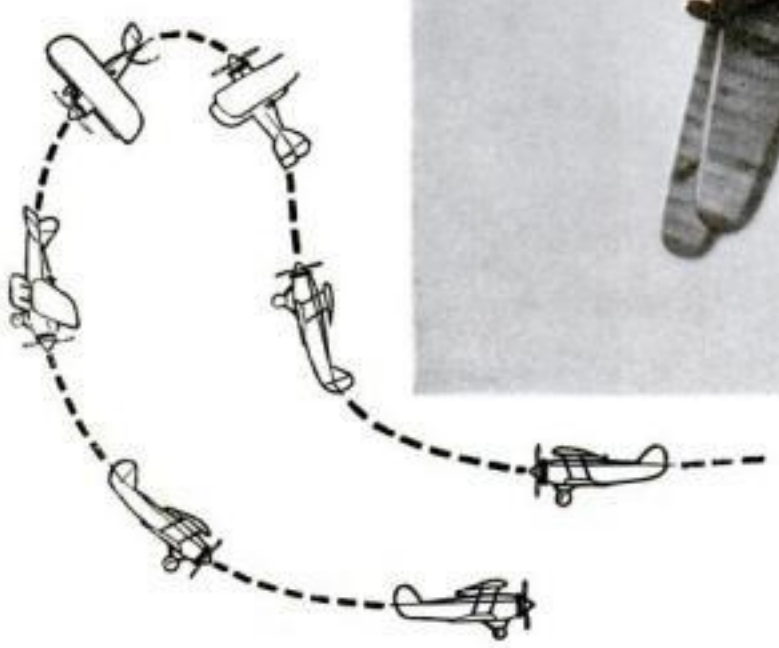
No sane pilot, under ordinary conditions, would attempt a stunt like that. The chances are a thousand to one against him. The slightest error in judgment, the least sluggishness in the controls, the smallest downcurrent of air, would spell disaster. First, last, and all the time, the rule for stunting practice is: have at least 1,500-feet altitude. However, if I had not practiced diving turns at safe altitude until I could perform them almost automatically, I would have been washed out in that Balkan pass.

THE nearer the ground a stunt is performed, the greater the danger. For this reason, the wartime chandelle—the zooming, sharply banked turn on the take-off—is one of the most treacherous of all aerobatics. It requires hair-trigger piloting. A stall at the top of the zoom and the ship plunges straight into the ground. War birds called this dangerous maneuver the "T.N.T. Take-Off."

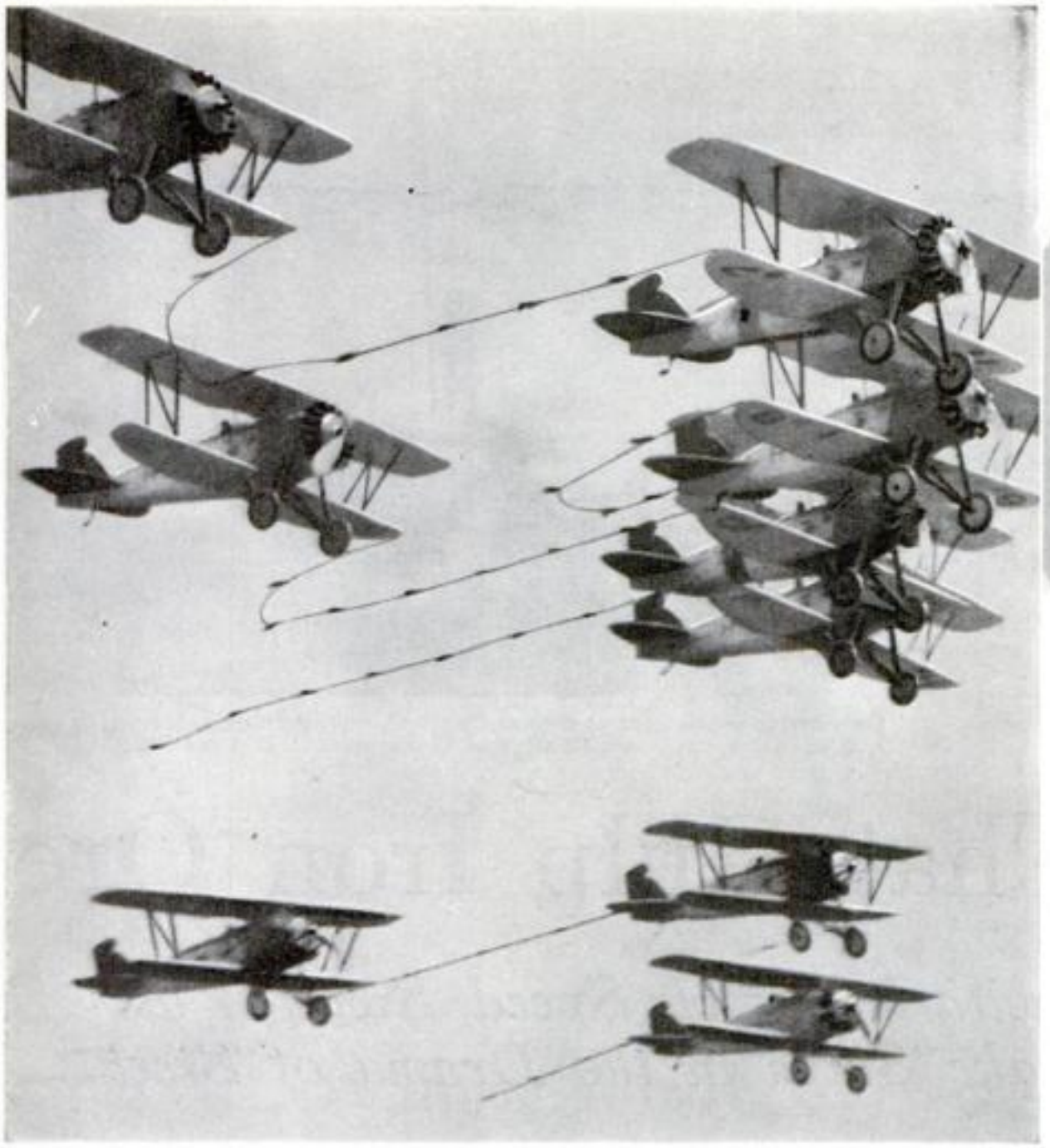
Yet, last summer, this same "dynamite stunt" saved me from a bad crash with four passengers on Long Island. I was taking off in a high powered cabin monoplane. The throttle was wide open. I was halfway across the field. The ship was traveling nearly a mile a minute. Then, without warning, a big plane lumbered out on the runway directly across my path. I couldn't stop and I couldn't turn without groundlooping my ship into kindling wood. I waited until the last second to get all the reserve speed possible and then, just before the ships crashed, I zoomed into a chandelle, turning as I climbed. We passed so close that the backwash of my propeller rocked the wings of the other plane.

It is in situations like these that stunt-





The plane above is at the top of the wingover stunt. As the ship zooms upward, it is banked and turned as sharply and steeply as possible. On the down glide both bank and turn are decreased until the plane levels off for flight.



In this Navy maneuver, Boeing pursuit planes are flown in tandem fashion with thirty-foot ropes between them, making hair-trigger accuracy of operation essential to avoid collision.

A Ford tri-motored plane coming out of a loop at the All-American Air Meet at Miami, Fla.

ing proves its value. More than any other kind of flying, aerobatics gives a pilot the skill, accuracy, and confidence to meet a crisis. It is not showing off; it is valuable practice.

Stunting really began in 1913, when the French flyer, Pegoud, climbed a Bleriot monoplane to 2,000 feet near Paris and looped the loop. Before that, steep dives, banks, and spirals just about completed the airman's bag of tricks. I remember well the day Pegoud made his loop. I was with the world's first war birds, the flyers who fought in the Balkan War of 1912–1913. When the news of the feat reached us, the war stopped as far as we were concerned. We sat around and talked for hours. Most of the pilots said it must be a fake, as they did not believe a wing upside down would support a plane, even for an instant.

This plane is upside down in the barrel roll. In this stunt all controls are applied and held on during the roll. Neutralize the elevators and apply the opposite aileron and rudder to stop the rotation.

Shortly after that, I made my first loop—to win a watermelon. This was the way of it. While I was flying with the Bulgarians in the World War, we captured a fast Le Rhone-Nieuport from the French. I used to get up at daylight and fly it for fun, zooming over the buildings and waking everybody up. Usually, when I landed, the other pilots would douse me with water as I entered the barracks door. One day one of them said: "If that plane is such a good ship why don't you show us some real flying? I'll bet a big juicy watermelon you can't loop her."

I took up the wager and hopped off with my teeth set. At 5,000 feet, I dove and pulled back the stick. Before I knew what had happened, the light ship shot up, over on its back, down, and I was leveling off again. I had looped the loop.

SINCE then, I have taught more than 200 students to perform loops and other stunts. The commonest mistake in looping, I have found, is pulling the stick back too far at the start. Another is letting the ship dive too far before leveling off at the end. I begin a loop with a slight power dive to gain excess speed. Then I pull the stick back gradually, holding it against my chest throughout the loop until the ship is coming out and diving at approximately forty-five degrees. Then I begin easing it forward so it reaches neutral position as the nose of the plane rises to the horizon. At the top of the loop, when the plane is inverted, I cut the motor. At the bottom, when the ship is leveled off, I open up the motor gently. On the upward zoom, I watch the horizon as long as possible, because that helps me keep the wings of my plane level during the execution of the maneuver.

An outside loop is one in which the plane makes a vertical circle with the wheels pointing in toward the center instead of away from it as in the ordinary loop. It is performed by shoving the stick clear ahead while the ship is in a vertical dive and holding it there until the plane comes out right side up at the top of the loop.

The queerest loop I ever made took place in the heart of a cloud. I wanted to test my sense of balance. I did. I couldn't see beyond my wing tips, for the fog was thick as cotton batting, so I had no horizon on which to level up my wings. One wing was low and I didn't know it. When I started to loop, I slid all over the

(Continued on page 157)

Ore-carrying vessels lying at dock at Cleveland, waiting for the unloaders, four of which can move 10,000 tons of the mineral in three hours.

Monsters That Gulp Iron Ore

Huge Machines, with Incredible Speed, Swing Vast Cargoes from Lake Ships in the Drama of Steel

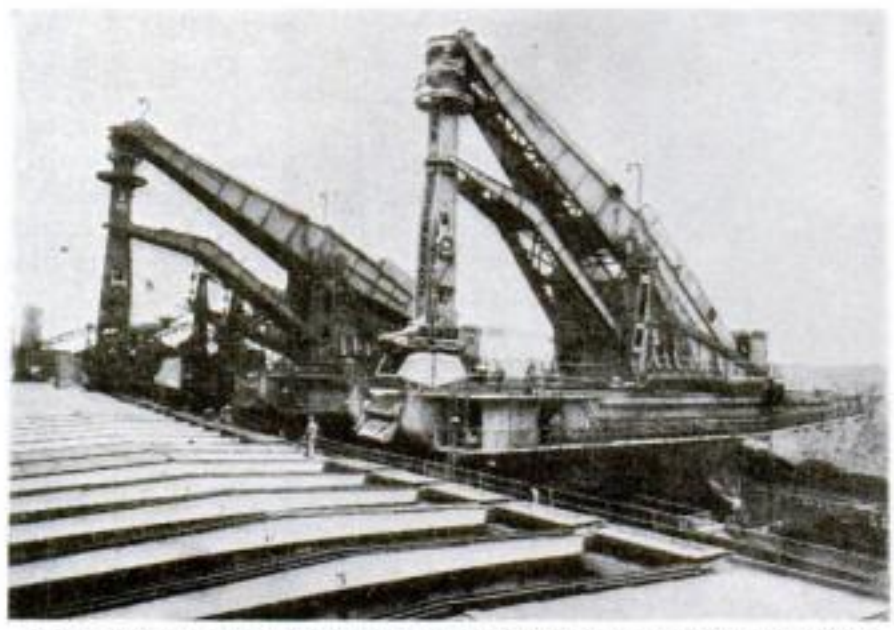
By STEPHEN SHERMAN

FEW more stupendous links in the chain of modern industry can be found than the ore unloaders of the lower Great Lakes. Super-powerful crane monsters, grasping tons of mineral as easily as a hand clutches sand, these tireless slaves of the steel world trundle more than eighty percent of the total iron ore shipped in the United States. Four of the mammoth unloading cranes, such as are shown on the cover of this issue, can transfer within three hours more than ten thousand tons of ore from boat to railway cars.

In 1852 the first half dozen barrels of iron ore from the Great Lakes region was shipped to Pennsylvania. By 1870 an ore carrier at one of the lower lake ports dropped a cargo of perhaps 300 tons. Many scores of stevedores working with shovels and wheelbarrows took a week to unload her. Today a vessel is eased of thousands of tons in no time, and the ore shipped yearly totals many million tons.

Although the loading of ore is spectacular, it is the unloaders that give the real thrill. Two types of them hold the field. First, there is the traveling bridge crane, so huge as to span a whole dockyard, which gobbles ore from the ship's hold with a cable-suspended clamshell bucket. The hoisting equipment to govern the bucket is housed in a trolley carriage that runs out along the bridge track to a mighty cantilever arm hovering over the vessel hatches. The trolley carriage may be run by motor drums placed in a stationary machine house, with the operator surveying all movements from a fixed point; or the operator may ride in a control cab suspended from the carriage itself.

The second and more spectacular type is the Hulett unloader, which is depicted on the cover. In construction it resembles a colossal "walking beam" of a river steamer with one leg lopped off. Its one leg is kept vertical by a girder brace hinged to the ponderous truck carrying the hundred-foot walking beam. Hence the name "stiff leg" unloader is often used by Great Lakes captains in referring to this device.



Mighty beams on these Hulett unloaders swing up and down carrying seventeen tons of ore at a load, filling and emptying once a minute.

IT IS this vertical leg that does the scooping of a vessel's hold. Like the bill of a titanic bird it drops thirty or forty feet into a hatch, taking seventeen tons at one mouthful with the bucket at its end. Then it swings up and out of the hold to weighing scales and a car where it dumps its load. The car, when full, slides along a suspension track to a position over an ore car which an electric "shunt" puts into place. The ore car is started on its journey to the mills, and the swift routine is repeated.

The Hulett unloader is controlled from a "brain center," a little cabin three feet square where the unloader is directed by four switches, at the bottom of the vertical leg just above the scooping bucket. The operator sitting in this brain center can run the whole giant back and forth along the squat trolley truck on which it rests, or move it sideways from hatch to hatch. A seventeen-ton load each minute is the pace generally maintained by nearly all of the unloaders.

POPULAR SCIENCE SCRAPBOOK

News, pictures, and brief bits about unusual people, places, and things from all parts of the world are shown on the following pages

Forced night marches on skis are part of the regular training of German guards in Riesen Mountains.

GERMAN NATIONAL GUARD TRAINED TO USE SKIS

SKIING on night patrols through forests of snow-shrouded evergreens is part of the work at the winter training camp of the German National Guard in Silesia.

Near Hirschberg, southeastern Germany, the heights of the Riesen Mountains are utilized as a practice ground for the hardy guardsmen. With guns and equipment strapped to their backs, they make forced marches over the snow-covered passes, camping at night in clumps of evergreens that are weighted with masses of snow. Such training in ski work is an annual feature of the hardening of the infantrymen of the Silesian section of the National Guard.

When the skiing Silesian soldiers rest, they build fires under the snow-covered trees.

ANIMALS CROSSED PACIFIC 55,000,000 YEARS AGO

FOSSIL remains of mollusks and other forms of marine life millions of years old have been found in the East and West Indies and in South America.

Dr. Willard Berry, of Ohio State University, recently described these fossils before the Paleontological Society in Washington. His conclusion is that these immigrants to America came by way of the Pacific Ocean. He does not argue for a former Pacific continent as a land bridge over the present ocean, but thinks these creatures crossed when the water was shallow and warm.

The marine animals described by Dr. Berry were chiefly from the Eocene period, and probably lived fifty-five million years ago.

NEW BAKING POWDER LEAVES NO RESIDUE

A FORMULA for a baking powder that leaves no trace of itself in the finished bread or cake has just been announced. It was originated by Edwin O. Wiig in the chemical laboratory of the University of Wisconsin. Its suitability for the general market is now receiving careful laboratory tests. The active agent in this new cake raiser has a powerful name, acetonedicarboxylic acid.

During the baking process, carbon dioxide gas, in the form of minute bubbles, raises the bread as does ordinary baking powder. Then the remaining portion of the new agent disappears as another gas, called acetone.

FILM PHONOGRAPH CAN PLAY ENTIRE OPERA

A PHONOGRAPH that uses a 400-foot reel of talking movie film as its "record" has just been perfected by Dr. C. H. Hewlett, of the General Electric Company. On this reel of film, which is small enough to fit in an overcoat pocket, an entire play, opera, or concert program can be recorded.

The invention is adapted from talking motion picture principles. However, since there is no picture to be shown, the entire width of the film is utilized for the sound records. In the present device, nine sound tracks run parallel for the entire length of the film, and when the film has run through once it shifts to the next sound track and repeats. These give a program of an hour and twenty minutes. The sound is recorded on the film, and reproduced in the long-playing phonograph, by simplified electrical apparatus similar to that used in the movies.

WINDIEST SPOT ON EARTH FOUND IN ANTARCTIC

ACCORDING to Sir Douglas Mawson, British explorer, who headed an expedition within the Antarctic Circle, the windiest spot in the world is Commonwealth Bay, south of Australia and several hundred miles west of Admiral Byrd's Little America. Sir Douglas' records were recently published in Australia.

The average wind speed during the

twenty-two months the expedition maintained a station at Commonwealth Bay was more than forty-four miles an hour. Speeds of ninety to one hundred miles an hour were frequent. At times, no records could be made because the wind recorders were blown away.

PARIS STREET CLEANERS USE DUSTPAN ON WHEELS

SHOULD this Parisian street-cleaning crew appear one morning in an American city, it might attract considerable attention. A team of two men would be seen going down the sidewalks, cleaning up at a rapid pace. In front would be a broomsman, sweeping refuse into small piles. Close behind would follow a man with a mysterious cart, which as it approached the heap would suddenly open its mouth, lower its under lip to draw it in like a dustpan, and close up again until another pile was at hand. When the container is filled with the sweepings, it is wheeled to a collecting station and emptied.

This coöperative plan of street-cleaning was recently put into effect on the famous Rue de la Paix in Paris, where visiting Americans marveled at it.

TANNIN STILL IN CHESTNUT LONG AFTER TREE DIES

THE domestic supply of tannin has been threatened by the blight of chestnut trees. But the United States Department of Agriculture, coöperating with chemists of the tannin industry, finds that the trees retain their tannin content sometimes as long as twenty-five or thirty years after they die, although they soon lose their bark and sapwood.

Prospects of finding and growing enough blight-resistant chestnuts to continue the extract industry are slight, searchers say. Work is being continued with promising trees and sprouts, although it appears that most chestnut trees, at best, are fortunate in merely escaping blight; they do not resist it.

Tannin is used in the dyeing and tanning industries and is the basis of ink and astringents. Chestnut extract contains fourteen to twenty percent of this valuable substance.

MEMORIAL HONORS MOTHER OF AIRPLANE INVENTORS

IN CONSEQUENCE of the biography of the Wright brothers which John R. McMahon wrote for POPULAR SCIENCE MONTHLY last year, a memorial tablet was raised recently in Hillsboro, Va., the birthplace of Susan Koerner Wright, mother of Wilbur and Orville Wright, the inventors of the airplane.

When Mrs. J. S. Grasty, of University, Va., read in POPULAR SCIENCE MONTHLY that the mother of the inventors was born in her State, she arranged with the State highway department to place a commemorative marker on the highway leading to Hillsboro, and later collected funds

John R. McMahon, Wright brothers biographer, at memorial tablet erected recently to their mother and sister at Hillsboro, Va.

for the memorial tablet shown here. The inscriptions on both marker and tablet were written by McMahon. The tablet stands above a spring opposite the site of the carriage shop of John Gottlieb Koerner, grandfather of the inventors. It is dedicated to the mother of the Wrights and to their sister, the late Katharine Wright Haskell.

TERN FLIES 9,000 MILES IN FOURTEEN MONTHS

A COMMON tern, member of the gull family, was banded in northern Labrador by Oliver H. Austin, Jr., in July, 1928. Fourteen months later it was seen and examined at the southern tip of Africa on the Indian Ocean, 9,000 miles away, which is thought to set a record.

The tern, or sea swallow, is usually smaller than the gull. Its bill is more slender, its feet not so strong, and its flight more graceful and dashing. The common tern is pure white with a cap and mantle of bluish gray and is sometimes hunted for its feathers. The all-white species live on Pacific islands; those with darker coats are widespread.

MUSCLE TEAMWORK GREAT AID TO SINGERS

SINGERS should take advantage of the natural teamwork between delicate vocal muscles and powerful breathing muscles, if they would increase their range and improve their tonal quality. This is the advice of E. M. Josephson and Minnie K. Willens, who have been experimenting in breath and muscle control. The fine network of muscles in the larynx box which control the voice and the large, powerful muscles of the chest and stomach region work together like hands on a clock. Singers who aid this coöperation, instead of working against it, will sing better and with less effort and fatigue, it is reported.

Three types of breathing are recommended for various ranges: for the high tones, a high chest breathing; for the middle tones, breathing which exercises the muscles of both chest and diaphragm; and for the low tones, breathing from the abdomen itself. Josephson claims that singing in this manner greatly improves the voice's tonal range and quality as well as vocal resonance, and at the same time reduces the strain on the voice muscles to a minimum.

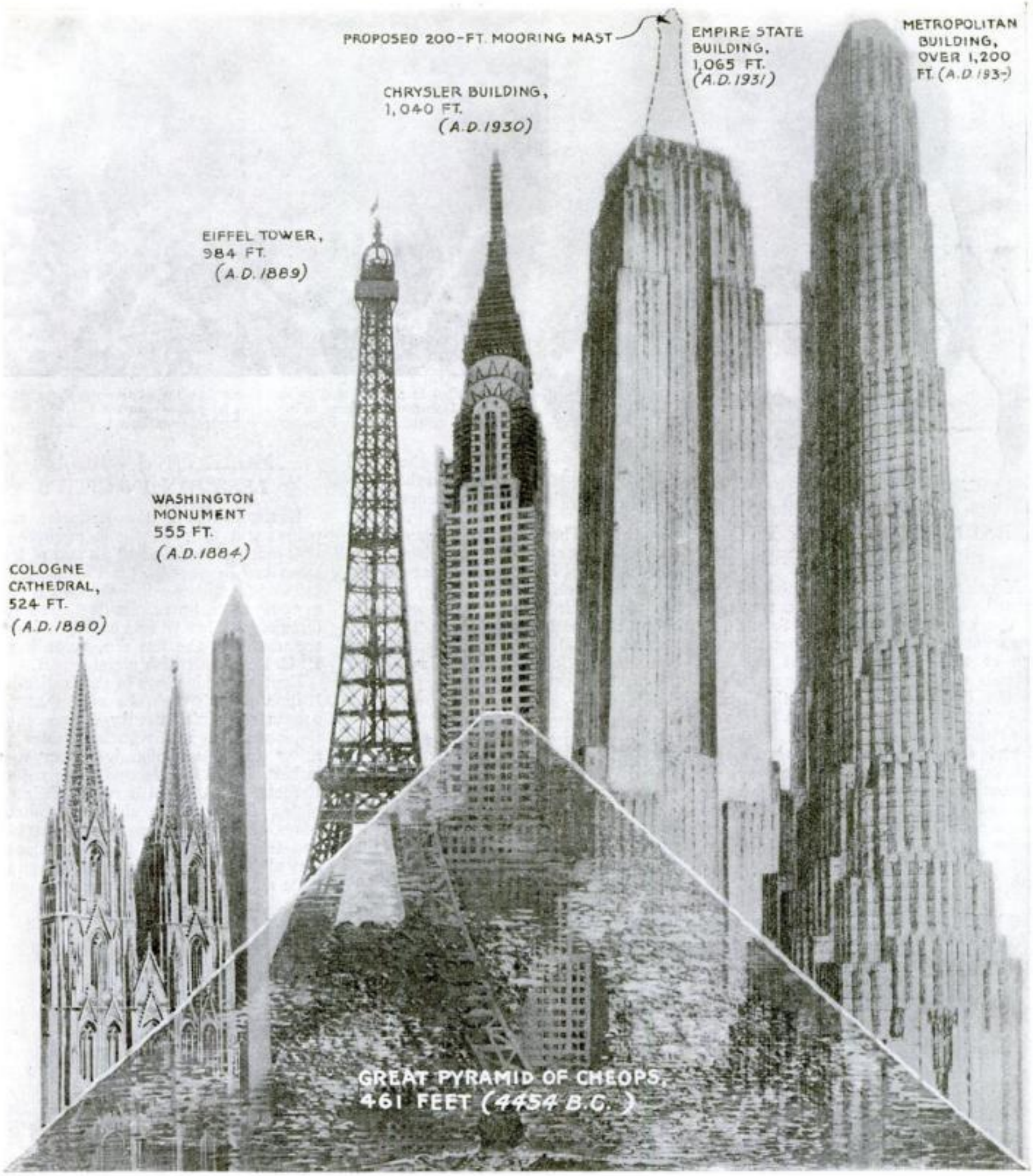
AMERICA'S SPONGE KING

"THE Sponge King of America" is the title given to Theodore Schroeder, of St. Louis, the head of two companies having a combined business of two million dollars. Only within the last fifty years has the sponge been classified as an animal, and not a plant.

Marine sponges, the type used in the sponge industry, thrive in fairly shallow sea water (a few hundred feet deep) and grow in enormous colonies, varying in size, form, and color. Sponges are fished in the Eastern Mediterranean, off the Bahama Islands in the West Indies, and off the west coast of Florida. The "sheepswool" sponges of Florida are considered especially fine.

For a thrilling story about Florida sponge fishermen in the Gulf of Mexico, see "Men Who Fight Sharks" (P.S.M., Sept. '26, p. 32).

Theodore Schroeder with a pair of large dried sponges, soon to be made into bath accessories.



Sixty-Three Centuries of Skyscrapers

WHEN the Chrysler Building in New York City recently reared its lancelike spire 1,040 feet above the street, it broke the 984-foot Paris Eiffel Tower's forty-year record of being the highest structure ever built.

Man's aspiration to pierce the clouds dates back to antiquity. Skyscraping began about 6,400 years ago with the 461-foot Pyramid of Cheops. After a lull of more than sixty centuries, the Egyptian marvel was overshadowed upon the completion, in 1880, of the 524-foot Cologne Cathedral, begun six centuries before. Then, in 1884, the Washington Monument was completed and surpassed the German edifice by thirty-one feet. Now towering structures of stone and steel, rising rapidly to dizzy heights, set new breath-taking records almost monthly.

Structural steel made the modern skyscraper possible. The Eiffel Tower, built for the Paris Exposition in 1889 (P.S.M., Oct. '29, p. 49), was one of the earliest structures in which it was used. Two of its giant successors, beside the Chrysler Building, are shown here. The eighty-five-story Empire State Building, now under construction in New York City, will soar to a height of 1,065 feet, surmounted by a 200-foot dirigible mooring mast. This will be overtopped by the Metropolitan Life Building, New York City. The exact height of this mighty structure of a hundred stories, just begun, is not yet known, but it will exceed 1,200 feet.

Oval: Rolled in a ball the dormouse sleeps feet up all through the winter. At left: Uncurled and come to life again he ventures to the end of a twig. Above: A rare flashlight of the little fellow peeping from his birdlike nest.

RARE GLIMPSES OF THE SLEEPY DORMOUSE

MONTHS of watching and waiting have earned for Dr. Ivar Arvidson, zoologist of the University of Upsala, Sweden, a remarkable collection of photographs of one of the most elusive and sleepiest animals on earth—the dormouse. Some of the best, reproduced on this page, illustrate strikingly the curious habits of this tree-living rodent.

Living more like a bird than a beast, the dormouse builds a nest of leaves and grasses that would do credit to a song sparrow. At winter's approach, it curls into a perfect ball within the nest and remains so until the warmth of spring starts the slow uncurling process and the quickening of its blood circulation. A sudden cold snap in the spring, and the dormouse rolls up into a tight ball again. Of a very shy and retiring nature, this little animal is always hard to find.

FIND SARDINES SPAWN OFF CALIFORNIA COAST

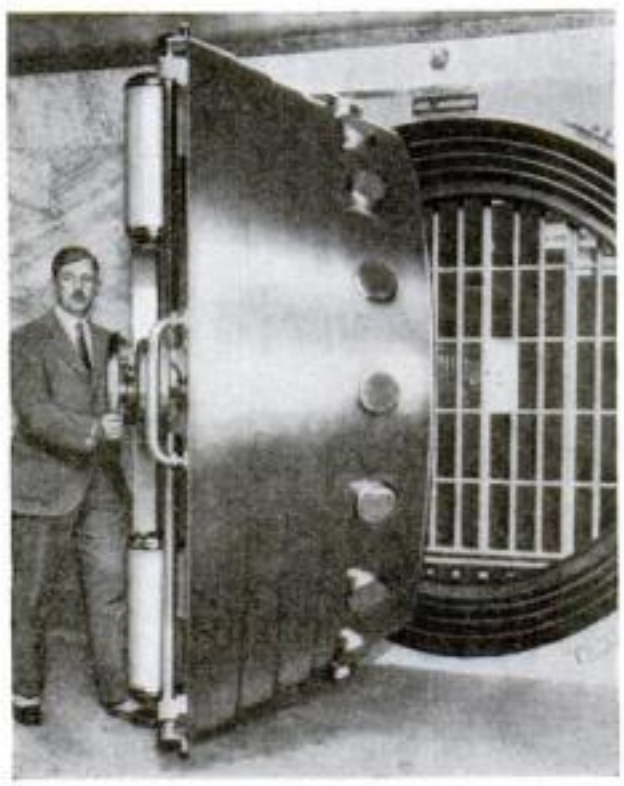
RECENT discovery of the sardines' spawning grounds is as important to the canning industry as to science. When fish are left to spawn naturally only fifteen percent of the eggs are hatched. When nourished in fish hatcheries, eighty percent of the eggs are saved. Sardines are no exception to this rule, and canners have long sought to learn where they go to spawn, in order to capture the eggs. The little herrings eluded their pursuers, but E. C. Scofield, scientific assistant of the California State Bureau of Commercial Fisheries, scoured the California coast from San Diego to Eureka, and finally tracked them to a place five miles off Point Vincent on the southern seaboard. Here he found schools of them and a great number of their eggs.

Many small fish are called "sardines," but the true sardine is a "pilchard," a small olive-green member of the herring family, abounding in the Mediterranean and off the west coast of France. Sardines are named from the island of Sardinia in the Mediterranean, where they are fished in great quantities. They are caught when young and, following cleaning, are washed, dried, and cooked in boiling oil. After the lids are soldered on in the canning, the tins are plunged in boiling water or steam before the venthole is sealed. This prevents bacterial decay. The largest sardine fisheries in the world today are off the coast of Brittany.

35-TON DOOR GUARDS BERLIN BANK VAULT

A SOLID steel door, two and a half times as thick as the armor on the greatest battleships of the World War, swings on its massive hinges before a vault in a banking house at Berlin, Germany. The steel portal weighs thirty-five tons alone, and with its metal and concrete foundation the entire entrance totals nearly four hundred tons.

The designers of the door maintain that it affords complete protection for the valuables stored in the huge safe whose entrance it guards.



A Berlin bank has this 35-ton door. It is 3 feet 9 inches thick and 7 feet 8 inches in diameter.

MORE TIN IN BELLS, LESS DIN IN CITIES

ENTHUSIASTS in the antinoise campaigns will welcome the announcement that much of the din and discord of large cities can be abolished if the makers of bells and whistles will only add a little more tin to the bronze used in their manufacture. It seems to be a simple case of the more tin, the less din, according to H. C. Dews, a British metal expert.

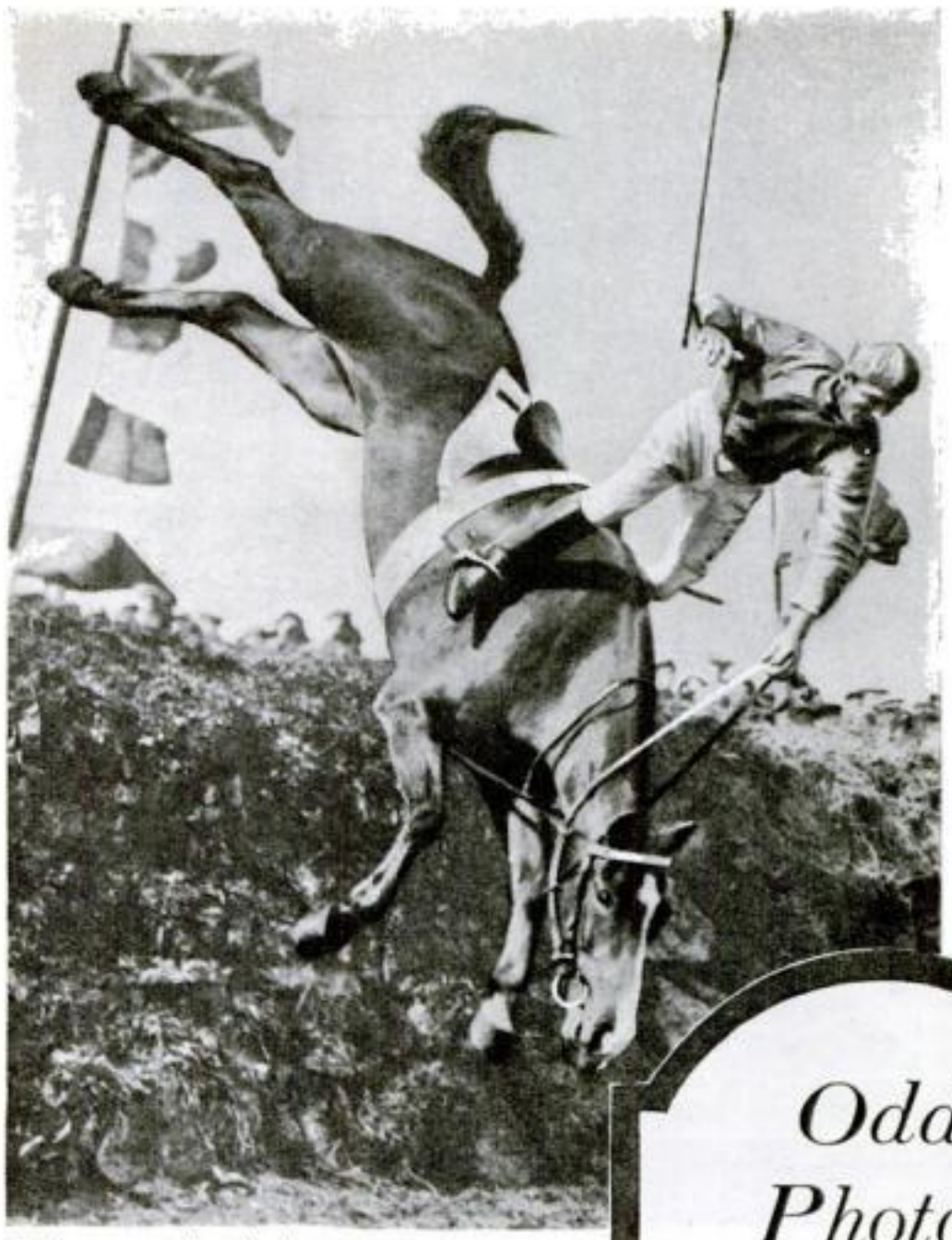
Expressing his views to the Institute of British Foundrymen, he said that fine bronze, containing twenty-five percent of tin, gives bells and whistles a finer and softer tone, less offensive than those fashioned with less tin and more copper. If metal foundries will revise their formulas, fog and fire sirens, ambulance gongs and motor horns, street car bells and telephones—even the alarm clock—may all have more musical voices, and the noise-racked public more peace.

AMERICAN BATH DAY SHIFTS TO SUNDAY

HABITS so personal as one's daily bath might reasonably be considered safe from the statistical searchlight. But no! Figures of home accidents, recently announced by G. D. Newton of the Travelers Insurance Company, reveal that more people take a bath on Sunday than on any other day of the week. Saturday is losing out. While records show a daily average of 120 bathtub accidents, about 170 occur on Sunday, over forty percent more than on other days.

Speaking statistically, the weekly "bath curve" of the American public has its peak on Sunday, drops a little on Monday, declines further on Tuesday and Wednesday, rises on Thursday, sinks on Friday, and then on Saturday starts climbing to Sunday's weekly maximum.

POPULAR SCIENCE MONTHLY is always pleased to answer questions on any subject within its field, if readers will address their inquiries to the Information Department, 381 Fourth Avenue, New York, inclosing a stamped, self-addressed envelope for reply.



This may not be the best way of clearing a stone barrier, but at St. Buryan Cornwall, England horse and rider went over like this and both escaped uninjured.

Odd Photos of Unusual Falls

An unusual photo snapped at Gatwick, England, when the horse hit a barrier and crashed clear over it.

This woman rider beat her horse over the hurdle.

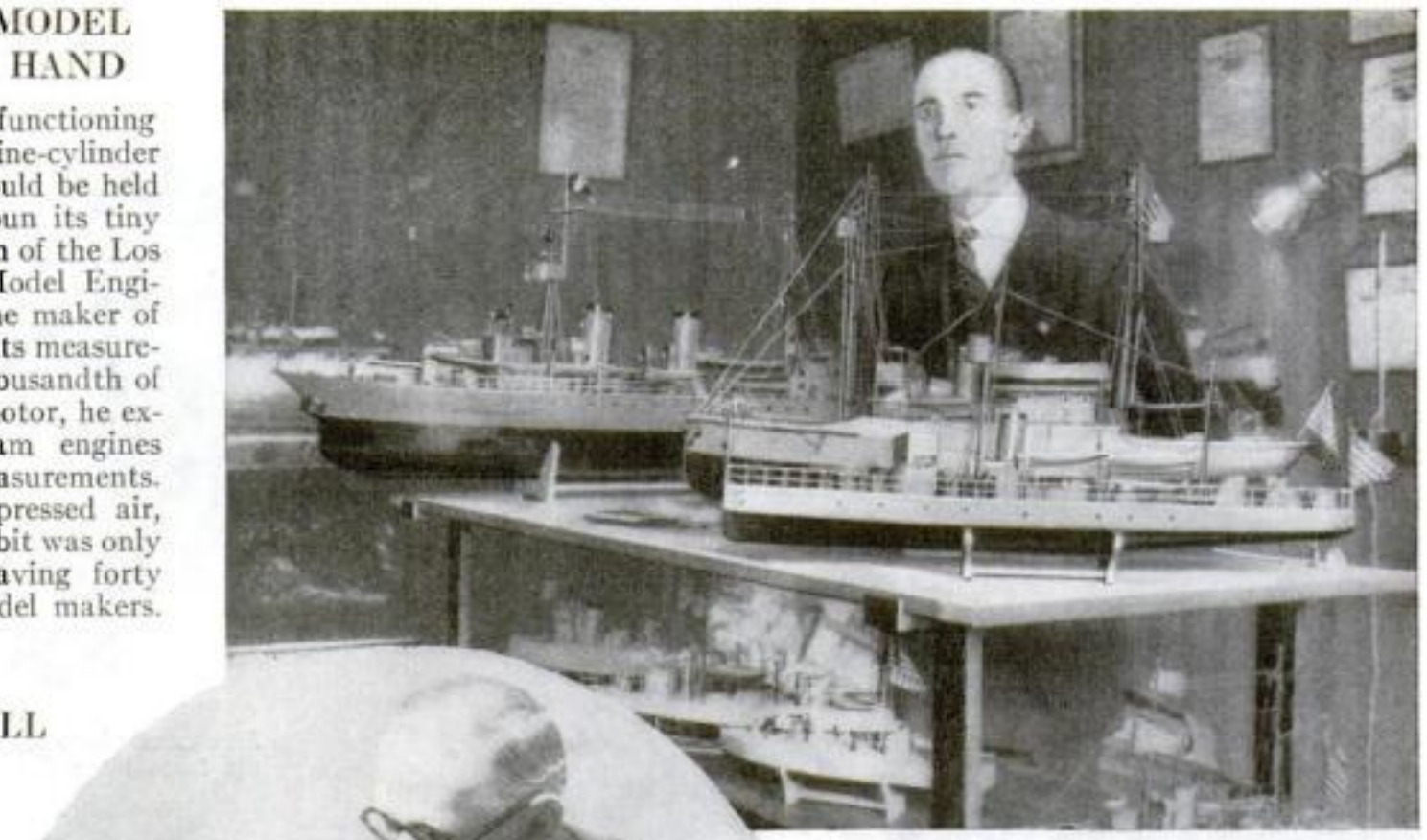
This jump at Newbury, England, turned into a nose dive for the mount and jockey when the hurdle proved to be too difficult.

An open ditch hazard stopped this racer but its rider kept right on going.

Spilled by a head-spin that broke the jockey's leg.

RUNS 9-CYLINDER MODEL ENGINE, SIZE OF A HAND

WITH 360 midget parts functioning perfectly, a model of a nine-cylinder radial airplane motor, that could be held on the palm of the hand, spun its tiny propeller at a recent exhibition of the Los Angeles, Calif., Society of Model Engineers. William X. Brown, the maker of the pocket-sized engine, says its measurements are correct to a ten thousandth of an inch. Besides the radial motor, he exhibited three types of steam engines made with equally minute measurements. Each of them, run by compressed air, worked successfully. His exhibit was only one of many, the Society having forty members, all enthusiastic model makers.



William X. Brown with his model engines shown at Los Angeles, Calif. A nine-cylinder airplane motor with 360 parts is seen second from the right. Each of the other three is a steam engine.

SIGNAL TO MOON WILL TEST RADIO RANGE

DR. A. HOYT TAYLOR, chief of the radio division of the United States Naval Research Laboratories, announced recently that he will attempt to send a radio signal to the moon. Dr. Taylor hopes that the moon's face will reflect the signal back to earth, where, since the moon is only 250,000 miles away and Hertzian waves are supposed to travel 186,000 miles a second, it would be picked up in Washington two and four fifth seconds after its departure.

This experiment would settle the question of whether an electrically-charged layer in the earth's upper atmosphere prevents the escape of radio waves. The supposed existence of such a layer has long been advanced as a barrier to an attempted radio communication with Mars. If successful, the experiment would set a new long-distance record for radio transmission.

Another long-distance record was made recently when a radio program, broadcast from Schenectady, N. Y., on a short wave, was picked up and rebroadcast at Sydney, Australia. After having traveled a distance equal to four fifths of the earth's circumference, it was received, and broadcast once more, by another station in Schenectady. Thus the two Schenectady stations were sending the same program, but the one relayed, due to its long trip, was one eighth of a second behind the other.

BROKEN WATER MAIN GIVES CITY A NATURAL GEYSER

PEOPLE passing along a principal street near the north end of Manhattan Island, New York, one afternoon recently saw the asphalt pavement suddenly begin to heave and crumble and a moment later a giant fountain burst forth. The geyser roared higher and higher until its crest was level with sixth-story windows. A large water main had burst, resulting in this brief picture of a natural phenomenon. It was brief because workmen soon repaired the leak, stopping the flow, but thousands of gallons of water were lost.

This geyser is roaring to the height of six stories from a broken main in New York City.

BUILDS 36 MODEL SHIPS FOR WAR AND COMMERCE

A MAN who commands a complete navy and mercantile marine of his own creation is Major Arthur W. Kipling (above), an American living in Paris. His collection of thirty-six ship models includes both miniature dreadnaughts and passenger ships. Six of his models were shown recently at the Salon Nautique, or Nautical Show, and attracted much attention.

HEAVIEST WELDED TRUSS HOLDS MILLION POUNDS

THE theory that welded steel girders are as strong as those riveted, recently received a drastic test in the heaviest welded truss ever constructed. This steel framework was made for a Glendale, Calif., mausoleum. According to engineers' computations, at the point of greatest stress it safely sustains a force of a million pounds.

"Gusset plates"—overlapping plates at the joints—similar to those used in rivet construction were an unusual feature of this heavy arc welding job. It is estimated that use of welded joints saved ten to fifteen percent in the quantity of steel used.

NEW DISEASE IN ENGLAND DRIVES BIG DOGS CRAZY

CANINE hysteria or dementia, a new dog disease, has recently become so widespread that the Royal Veterinary College of Great Britain has begun research into its causes, symptoms, and treatment. Its causes are so far unknown, but big dogs generally are its victims. The diseased dog may suddenly howl and rush off on a run of several miles, and perhaps will kill himself by crashing into an obstruction. The disease first made its appearance in England in 1924, but "running fits," similar in symptoms, have long afflicted American dogs.

wich Observatory show the time disks where the clock-setting time signals are controlled and a "sidereal" or star clock. This sidereal clock gives the time measured uniformly by the axial rotation of the earth as referred to a star. One complete rotation measures off a sidereal day. The clock is sealed in a glass case kept at a temperature of sixty degrees Fahrenheit.

The observatory was established in 1675. England, during the reign of Queen Elizabeth, had become the greatest maritime power in the world. To this fact the observatory owed its origin, as it was designed "to further navigation and the advancement of nautical astronomy." A curious feature is a magnetic pavilion, so placed as to prevent disturbance of delicate instruments housed in it by the iron in the main structure.

At left is the standard star clock kept at Greenwich. At right is tablet marking zero meridian.

At left, room from which all the world gets its time. Disks control the signals.

GREENWICH CLOCK KEEPS TIME FOR ALL THE WORLD

UNUSUAL pictures were recently taken giving glimpses behind the scenes at the famous Greenwich Observatory in England, which, by common agreement, has become the time reference point for the entire world. The observatory is perched on a hill at the point through which the "zero" meridian passes, and from which longitudes are measured. "Greenwich time" was adopted as the standard in the United States in 1884, and is dispatched daily from the United States Naval Observatory in Washington, D. C.

The photographs taken at the Green-

Which Five Inventions Are Greatest?

Announcing the Prize Winners and a Summary of their Selections in POPULAR SCIENCE MONTHLY'S February Contest

WHICH five inventions are the greatest?

Everything from the alphabet to the vulcanizing of rubber. That is the impression received by reading the answers of hundreds of contestants, submitted in the prize contest recently announced in this magazine (P. S. M., Feb. '30, p. 44).

From these manuscripts the Editors of POPULAR SCIENCE MONTHLY, as judges, have completed the task of selecting the prize winners. The awards are listed herewith. Because of ties among the contestants for the $5 prizes, under the rules of the contest a full prize was awarded to each of the tying entries. Therefore, in addition to the First Prize of $50 and the Second Prize of $25, there are seven prizes of $5 each instead of five as originally announced.

Sidelights of the contest were interesting personalities revealed among the contestants. A high school girl of seventeen won one of the prizes. Another manuscript among the prize winners was submitted by an orphan girl of eighteen, studying at a school for the blind.

FIRST PRIZE, $50

EUGENE W. BLANK, State College, Pa.

SECOND PRIZE, $25

E. B. BENSON, Rock Island, Ill.

SEVEN PRIZES OF $5 EACH

DR. HEBER BUTTS, Nashville, Tenn.
MARY DOLORES DESS, Baltimore, Md.
RALPH L. FARR, Athol, Mass.
JOHN D. GRESIMER, Ardmore Park, Pa.
S. S. PARKISON, Broken Bow, Nebr.
LOUIS H. RODDIS, JR., Washington, D. C.
ELLA SHEFFIELD, Muskogee, Okla.

Clearness, conciseness, neatness, and skill in presentation were factors on which the judges based their awards. Many of the contributions showed a surprising amount of effort and ingenuity in their preparation, and a high standard of excellence characterized most of the entries.

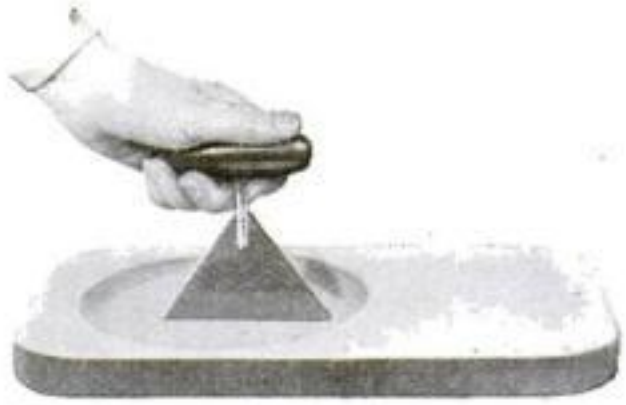
The prize winners' selections of "greatest inventions" makes an interesting tabulation. This was as follows:

Printing and printing process, 7; electric lamp, 6; steam engine, 6; dynamo, 3; radio, 3; telephone, 3; Bessemer converter for steel-making, 2; cotton gin, 2; wheel, 2.

Also the following, which received one vote each: alphabet, boat, cement, mariner's compass, induction coil, microscope, money, plow, telegraph, telescope, vulcanizing of rubber.

Thus, the leading selections among the inventions may be said to represent the basic aids to civilization of education, light, and power. They are followed by representative examples of communication and of the manufacturing and structural arts. It might be hard to place in more appropriate order the fundamental gifts of invention to mankind.

Home Conveniences That Save Time



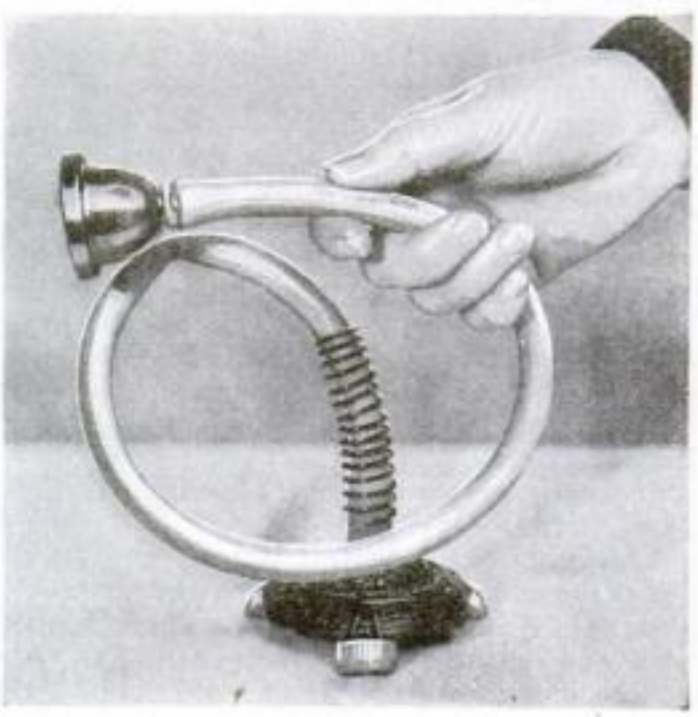
With this new sandwich board fillings are minced in the bowl, and then spread on the bread on the flat surface. To cut bread, the board is turned.

Abundant heat to get up by on cold mornings is provided by this aluminum electric heater. It can be carried easily from bedside to bathroom, and tucked against wall when not in use.

In this combination tray and serving table, the legs drop at the touch of a button; or they fold out of the way, to conserve space, when not needed.

Boiling water is quickly supplied at any hour with this electric teakettle that plugs into any wall socket. A thousand-watt heating unit is built into the base.

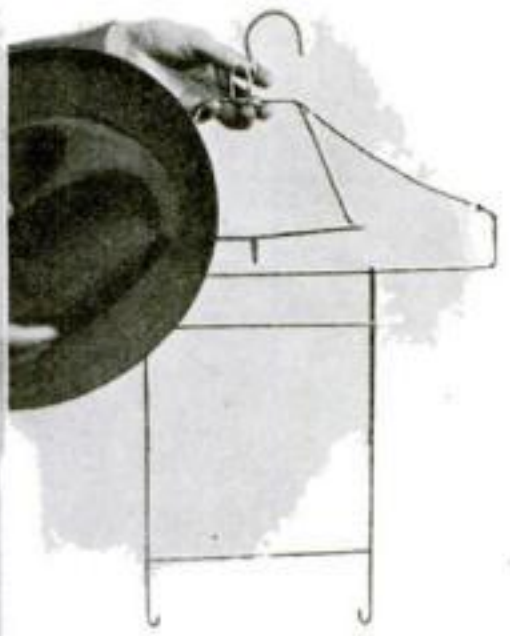
Pushing a foot pedal swings open the door of this new refrigerator without stooping or setting food down when hands are full. A dial thermometer in front tells when box needs ice.



This simple appliance prevents a steaming bathroom and muffles the sound of running water. The nozzle slips over faucet; the water flows through tube and out the base, filling tub beneath the water's surface.

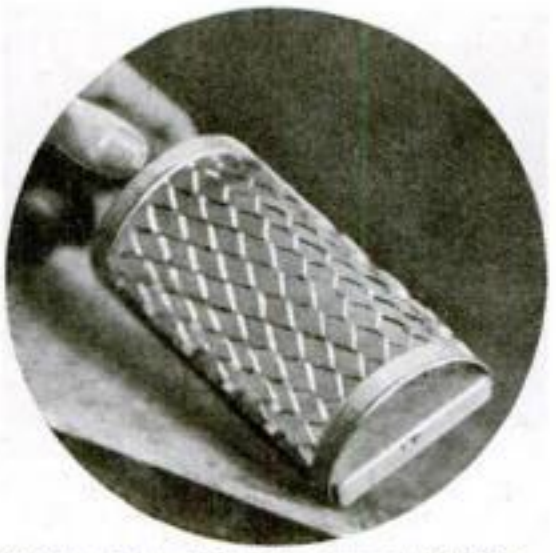
Serving three purposes, this rubber squeegee is shown above as a sink scraper. It is also used to clean windows and to scrape plates.

This electric dishwasher dries the dishes, too. An electric fan supplies the drying air which is heated by a hot coil. The device sets on the drain board when in use and under the sink when its job is finished.



Anyone can keep his clothes in one place with this novel space saver. The special built-in rack holds hat, coat, vest, shirt, trousers, and tie.

Hot water at any desired temperature is always ready with this simple electric heater. Independent of the main hot water supply, it is controlled automatically by an electric switch that starts the heater the instant the faucet is turned and water flows. Dial regulates temperature from 110 to 190 degrees.



Quick and handy is this compact shredder and cutter. A semicircular grating of metal tape grates anything from apples to hard-boiled eggs, and removes corn from the cob.

These oilcloth curtain protectors keep curtains clean and dry when windows are up at night. In daytime they are rolled back and snapped to window, out of sight.

Broiling on this combination grill and skillet gives the chop or chicken the same delicious flavor as charcoal broiling. The cooking is odorless and greaseless; ribs at bottom hold the meat out of the grease, which runs down into grooves.

A novel "laundry car" makes stooping unnecessary when hanging wash on the line. It rolls along carrying the clothes and pins at handy height. It weighs but seven pounds and folds into small space. It can be used as a bassinet or to hold the baby's bathtub.

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Let Science Decide Prohibition

THE fact that there is a prohibition problem at all is little short of ridiculous. The whole question hinges on the effect of alcohol on the human system, and obviously this is wholly a scientific problem. Yet the subject has been so befuddled by politics, prejudice, bigotry, ignorance, and emotionalism on both sides of the question that the authoritative voice of science has been lost in the clamor.

Why not stop listening to the rabid prohibitionists and the equally rabid antiprohibitionists and put the whole question up to the scientists? In spite of the oceans of words that have been printed on the subject, no one really knows what effect alcohol has on the human system. Let the scientists, definitely and conclusively, solve this problem. Let them dig deep into alcohol's effect on the body and on the brain. Let them weigh the bad effects of liquor against the advantages. Some of the bad effects are only too obvious, yet it is probably reasonable to ask whether a custom that has persisted continuously since the dawn of civilization can be wholly bad. At all events, let's throw out the emotionalism and get down to cold, hard, scientific facts!

Small Animals and Big Names

UNLAMENTED and unsung, the remarkable title of *Brachyuropushkydermatogammarus* is lost to zoology and its textbooks. This was the name that a certain zoologist, Dybowski, proposed to fasten upon a small crayfish of Siberia. The crayfish could not protest, but fellow zoologists could and did. The International Commission on Zoological Nomenclature, which had the final say in the matter, ruled "thumbs down," and the name is officially banned.

The zoologists' aversion to pinning such a name upon a small crayfish is to be commended. But its rejection does not improve an alarming state of affairs. Already 160,000 separate families are listed in zoology. The names are increasing, with new discoveries, at the rate of 1,500 a year. What will zoologists do when the good old simple names run out? Will they resort to numbers to increase the number of combinations?

Movie Records of Progress

WITHIN the last few weeks the morning mail of the Port of New York Authority has contained more than one letter from private citizens urging that moving pictures be made of two spectacular bridge-building feats. One is the Hudson River Bridge, with the longest suspension span in the world, which will join New York City with New Jersey. The other is the Kill van Kull Bridge, the world's longest arch span, which will connect Bayonne, N. J., and Port Richmond, on Staten Island, N. Y. As historical records, citizens urge, movies of these unique projects should be added to the usual written and statistical records.

The letter-writers, however, did not know that the Port Authority was already doing that very thing. Cans of film resting in its office contain movies showing the construction of the Hudson River Bridge's anchorages and towers. Cable spinning will soon be added, and the movie (expected to be of five reels) will be completed when the floor is laid. Meanwhile another film will depict the erection of the Kill van Kull Bridge's steelwork, of which 800 feet of film have been exposed.

Pumping Heat from Outdoors

THERE are skeptics who doubt that in the future electrical age homes will be heated by electricity. Lack of efficiency, they say, will forever bar the use of electricity for heating in competition with coal or other fuel burned under a boiler.

Considering that the maximum overall efficiency of the finest generating plants is only about twenty-five percent, and coal burned under a boiler in the home gives just about the same heat efficiency, the future of electric heating does not appear bright.

However, as T. G. N. Haldane, a British engineer, recently pointed out in a paper read before the Institution of Electrical Engineers, the efficiency of electricity in heating can be increased between 300 and 500 percent by using the electricity to pump heat instead of to produce it. His idea, which appears to be scientifically sound, is to convert the electrical energy into mechanical energy by means of motors and then use the motors to pump heat, on the Carnot principle, from a low to a high temperature.

This would mean, in effect, to build an electric refrigerator on a grand scale and operate it backward. Enormous coils, perhaps forming part of the walls or roof, would serve to absorb heat from the air, and this heat would be pumped in and transmitted to the air in our homes by radiators not differing greatly from the types now in use.

Looking for a Better Sugar

BESIDE the trade-mark on the family package of granulated or lump sugar, we have grown accustomed to seeing the word "cane." So commonly is cane sugar associated with sweetening that it is hard to take seriously the suggestion that a better sugar, not a substitute, may banish it from the table.

What that "better sugar" is, is not at all a matter of speculation. It is "fruit sugar," otherwise known as levulose. It is sweeter than cane sugar, is thought to be more healthful, and looks exactly like cane sugar. Recently it cost from $30 to $110 a pound. Now expert chemists of the United States Bureau of Standards are well on their way toward making it available to everyone at prices comparable with cane sugar. As described on page 55 of this issue, they are learning to produce it in quantity. Whether commercial production is to follow remains to be seen.

They Are Saying—

"THE biggest thing the American people can do during the next year is to pay more attention to engineers than to politicians."—Thomas A. Edison.

"A New York skyscraper is a delightful and fascinating monument of folly."—Alistair MacDonald, architect son of British Premier Ramsay MacDonald.

"The suspension bridge is the bridge of the future. It will not be unusual to see 6,000-foot spans."—Ralph Modjeski, famous American bridge designer.

"The world is menaced by a shortage of superior scientific brains. We no longer have the conditions which created the great scientists of old."—Dr. Edwin R. A. Seligman, Columbia University.

"Vital bodily functions are retarded from twenty to ninety percent by amounts of alcohol contained in beer and light wines."—Dr. Francis G. Benedict, director of the Carnegie Nutrition Laboratory, Boston, Mass.

Circuits That Improve Tuning

Selectivity Depends Upon Number of Tuned Stages Through Which Signals Pass, but Too Sharp Adjustment May Spoil Tone Quality

By ALFRED P. LANE

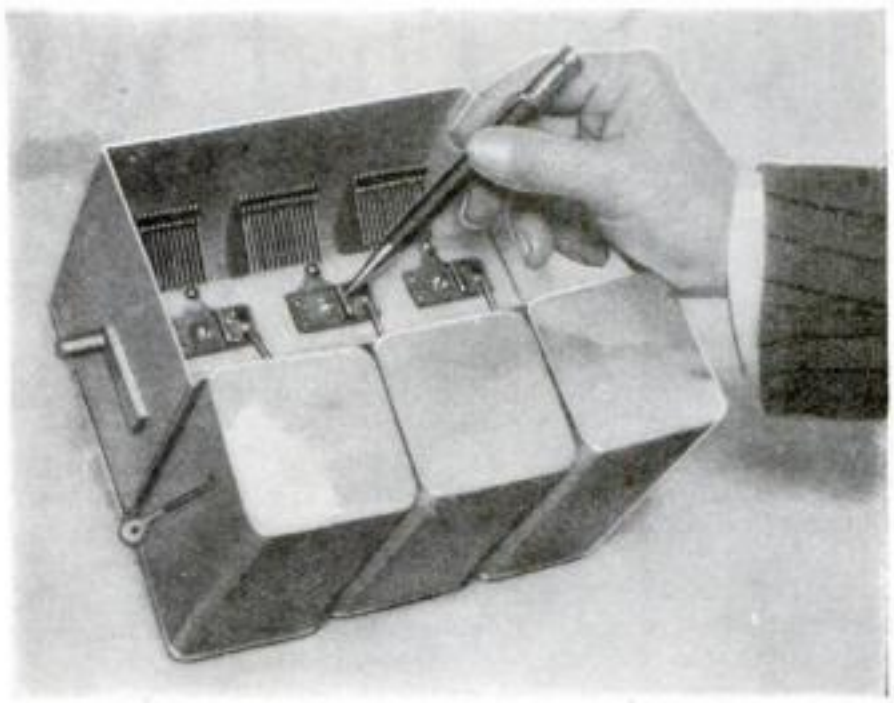


Fig. 1. This factory-built pre-selector unit is wired as shown in Fig. 2. Note the trimming condensers used to obtain exact synchronism between the various stages.

SELECTIVITY in a radio receiver is of vital importance. In fact, ability to tune-in a desired station without interference from others on adjacent wave lengths is, under modern conditions, absolutely necessary.

However, sharp tuning is not the only requirement. Too much sharpness is fatal to tone quality. If carried to theoretical extremes, so that the receiver would respond only to a single wave length or frequency, speech would be heard as an unintelligible mumbling, and musical tones could not be recognized.

A modern broadcast station transmits on a band of frequencies nearly ten kilocycles wide. This width is needed for adequate and faithful reproduction of speech and music. The ideal receiver should, therefore, bring in the necessary frequencies on both sides of the rated wave length of the station and reject all others. Actually the best of modern receivers fail to meet such exacting requirements though they may, at some one point on the tuning dial, roughly approximate it.

The portions of the transmission on each side of the specified wave lengths of the broadcast station are called side bands, and a great many radio fans have the impression that the how and the why of these side bands are too complicated for the average man to understand. This is not so, as the reason for side bands is simple. For good sound reproduction, it is necessary to transmit frequencies up to nearly 10,000 cycles so that the overtones of musical instruments, which makes them sound natural, may be included. These sound frequencies are impressed on the carrier wave frequency, and the resulting wave from the station actually consists of a group of frequencies, each one of which represents the sum or difference of the fundamental frequency and one of the sound frequencies.

Obviously, the lower the tone the nearer will be the transmitted frequency that carries it to the fundamental wave of the station; and conversely, the higher the tone frequency, the greater will be the diversion of the corresponding transmitting frequency from the fundamental wave length of the transmitter.

THE sharper the tuning, the more tendency there is to cut all frequencies that differ from the fundamental station wave length; and because the frequencies representing the higher tone diverge farthest from the fundamental, extremely sharp tuning results in what is known as cutting the side bands and consequently the higher audible notes.

Extremely sharp tuning, therefore, results in throaty voices hard to understand and musical instruments that sound hollow and unlifelike. The mellow tone is produced by side band cutting either through too sharp tuning or by actual suppression in the audio amplifier end of the radio set.

For the finest tone quality, a broad-tuning receiver would be desirable if it were not for the fact that there are so many stations operating. The radio designer seems, therefore, to be between two fires. If he makes the receiver broad enough to get the best possible tone quality, he will be bothered with interference; and if he gets it so sharp that interference is impossible, then the tone quality will be bad.

A partial solution seems to lie in the so-called band selector circuit, also referred to occasionally as a pre-tuning circuit.

Other conditions being equal, the selectivity of the receiver depends on the number of tuned stages through which the signal must pass. A single tuned stage sufficed in the days when only a few stations were on the air, but the modern set requires anywhere from three to five or even more tuned stages. Furthermore, the screen grid tube, because of its extreme amplification, has made it possible to use tuned circuits without tubes. The signal passing through these tuned stages is separated from the waves of interfering stations even before it strikes the first radio-frequency amplifier tube of the receiver.

Such a circuit is shown in Fig. 1. The incoming signal goes through three tuned stages before it strikes the grid of the first radio-frequency amplifier tube. A commercially built pre-selector circuit unit of this type (Continued on page 155)

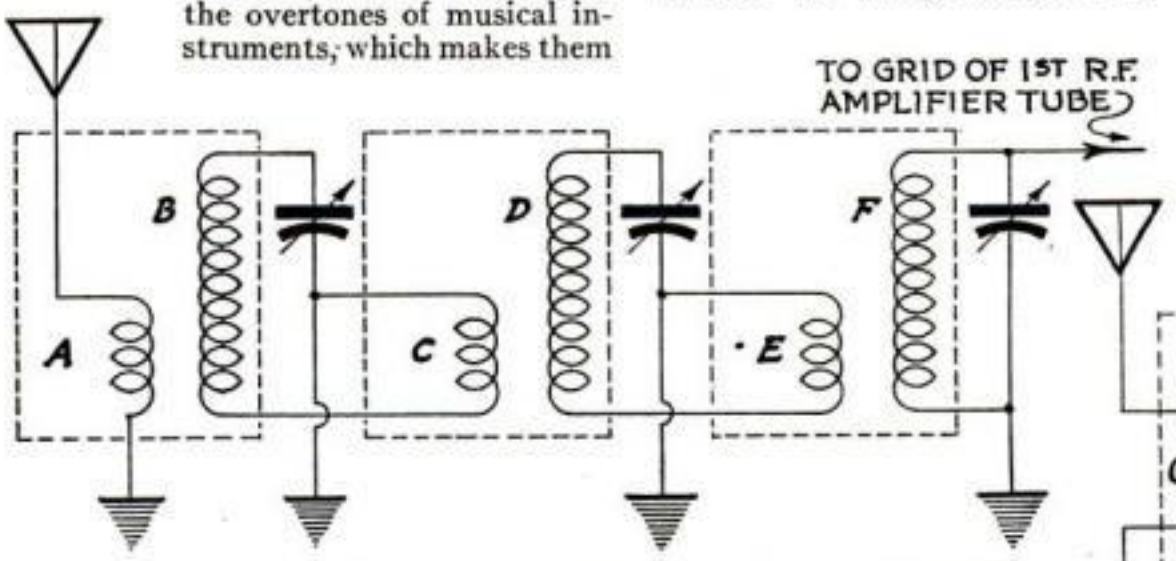


Fig. 2. A good pre-selector circuit using electromagnetic coupling. Dotted lines indicate shielding. Constructional details for the amateur builder are given in the text.

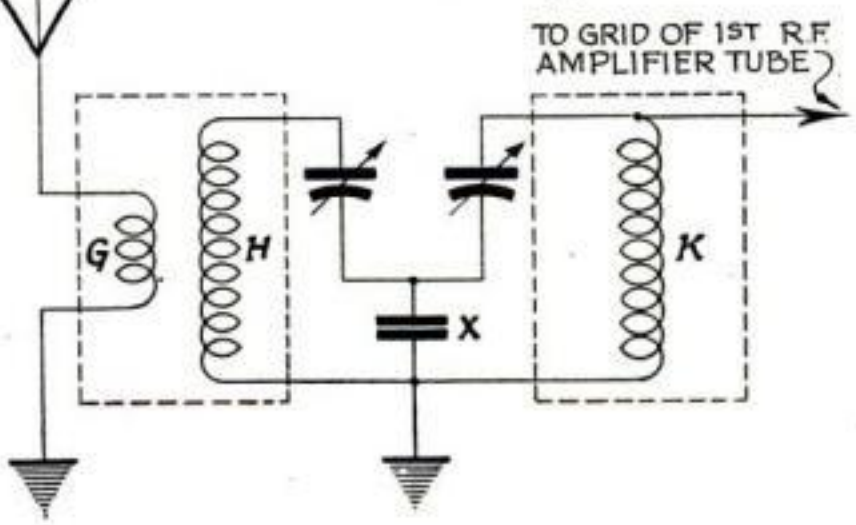


Fig. 3. This pre-selector circuit uses capacity coupling between stages. A two-gang condenser and homemade coils and shielding can be used.

HELPFUL HINTS FOR RADIO FANS

Tools That Will Save You Time

Screw Drivers Fitted to the Job Essential to Good Work—How to Test a Dead Set

YOU will find some jobs in radio so difficult as to be almost impossible if you haven't the right tools. You might, for example, spend a lot of time and energy in boring a hole through a piece of wood with a penknife. With a hand drill you can do the same job a lot better in a few seconds. Even a beginner knows enough to get a drill instead of abusing his penknife. Yet radio experimenters often waste hours of time for lack of some simple tool designed for the out-of-the-ordinary job.

One screw driver, for instance, cannot possibly meet all requirements. Although a single, well-worn screw driver often is the only tool of its type possessed by the radio amateur, much time and annoyance will be saved by investing in several special varieties.

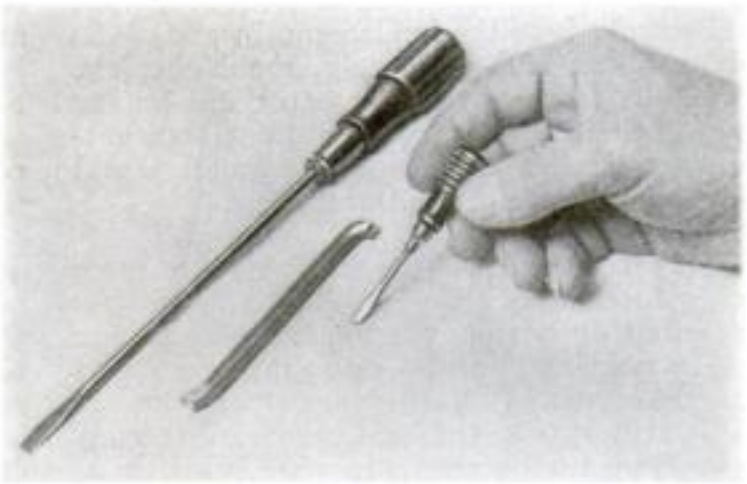
The illustrations on this page show three types of screw drivers that are particularly useful to the radio enthusiast, and, in fact, should be a part of the equipment of every home workshop.

Often a screw has to be tightened that is located close to the side wall of a metal shield or some other bulky part. A long-bladed screw driver makes such a job easy. A short-bladed screw driver often cannot be used at all except by holding it at such an angle that the head of the screw is inevitably marred.

Another apparently difficult job is to set up a screw where there is no room behind it to use the ordinary screw driver. A double ended screw driver of the right-angle type makes easy an otherwise "impossible" job. Such a screw driver is shown in the center of the illustration. This particular model has been ground down so that the working edges are as close as possible to the center line of the handle. Such screw drivers should be made double-ended so that the blade on one end can be crosswise of the axis of the handle and the blade on the other end set in a plane parallel with the handle. There are many cases where the screw cannot be got at directly or through a full circle.

At the right of the illustration is a short, small screw driver that will be found particularly useful for a large number of jobs. Set screws for shaft couplings, set screws on dials, and so on, are easily handled by this particular type not only because the blade is thin and narrow but also because the screw driver can be used in a restricted space.

With any type of screw driver it is important to keep the blade in good shape with a clean-cut, square end. A worn and consequently rounded blade often will slip out of the slot in the screw head almost regardless of the amount of pressure applied. A sharp and properly shaped blade requires little pressure to keep it in place. When blades become dull or bent grind them square again.



These three special screw drivers will save much time and trouble. They should be in every radio enthusiast's tool kit.

No More Rejuvenation

MANY radio fans recall that in the days of battery operated receivers it was common practice to rejuvenate apparently worn-out tubes. The 201A tube, for example, was the type on which this rejuvenation process was most popular and successful. The question arises as to what can be done to rejuvenate the modern type of A. C. tubes used in electric sets. The answer is—nothing.

The older battery operated tubes often became prematurely exhausted because the electron-producing material on the surface of the heated filament was used up faster than the supply could be renewed from the interior of the filament. The various "cooking" processes, otherwise known as rejuvenation, resulted in boiling out a fresh supply of electron-producing material.

Modern A. C. heater type tubes, including the -24 A. C. screen grid type and the -27 heater, amplifier, or detector as well as the rectifying tubes and power tubes now in use, employ a different type of material to supply the electrons, the nature of which is such that it will continue to supply electrons throughout the normal life of the filament itself. If by chance an abnormally long lived filament is encountered, so that the electron-producing material actually becomes exhausted, there is no way to rejuvenate it, as the electron-producing material is all gone. In modern heater type tubes, the heating filament itself will last, on the average, as long as the electron-producing material on the cathode.

When the Set Goes Dead

ALTHOUGH radio service men claim that about eighty percent of the calls they get these days turn out to be tube trouble, there still remain calls caused by trouble in the set itself.

When the set goes dead the first problem is, therefore, to determine whether it is tube trouble, and in many cases it will save the time and expense of a service man if all the tubes are taken to the nearest radio store for testing.

If, however, a test shows that the tubes are all right, then the set owner can either call in the radio service man or attempt to locate the trouble himself. Many times the difficulty is absurdly simple. For example, radio service men report that an astonishingly large number of service calls turn out to be a current supply plug dropped out of the wall socket or the antenna or ground wire come loose at the binding post. These, are troubles that the owner should find for himself.

When the loudspeaker is not built as a unit in the same console cabinet with the set, there is the chance that the loudspeaker plug has come out of the socket. Even in the complete unit receivers, the speaker cord tips usually are plugged into special jack sockets in the receiver unit.

A B C's of Radio

THE object of shielding a radio receiver is to isolate one circuit from another so that each can do its proper job without interference. The effectiveness of any shielding depends, in most cases, upon how completely it is carried out, the conductivity of the metal used in building the shields, and its thickness.

Surrounding a coil with side walls of metal accomplishes something, but the shielding cannot be complete until a top and bottom are included.

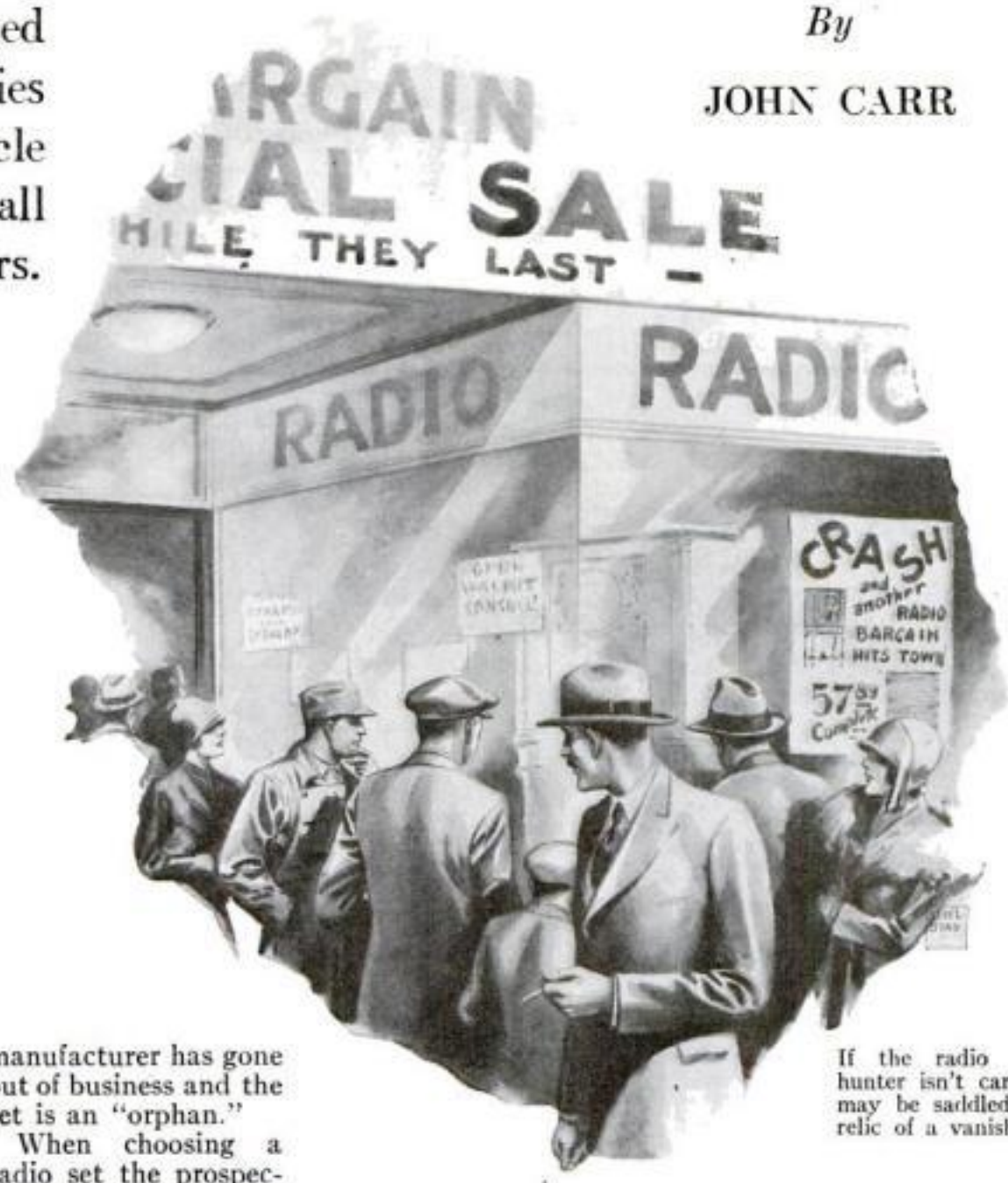
Furthermore, it is important that the top and bottom, and in fact all joints in the shielding, make good electrical contact with the side walls, and so on. Generally speaking, the more radio-frequency amplification obtained per stage in any given circuit, the more complete must be the shielding.

In Radio—Look before You Buy

Careful examination is needed when an uninformed fan tries to get a cheap set. This article tells what to look for in all the so-called bargain offers.

By

JOHN CARR



If the radio bargain hunter isn't careful, he may be saddled with a relic of a vanished age.

THE uninformed radio buyer who looks for a receiving set at a bargain price is seriously handicapped. Instead of a bargain he may find himself saddled with an ancient relic of a bygone radio era—a set that didn't amount to much in its day and is of even less value when compared with a modern outfit.

Of course, now and then there are bargains in radio equipment, just as occasionally a secondhand car appears on the market in such good condition that it is a real bargain. Usually, however, a bargain radio set is a bargain in name only. It is sold cheaply only because nobody is willing to pay a higher price for it.

Sometimes, because of overproduction, the market is temporarily glutted and sets are sold at less than their intrinsic value. That is why the phrase "manufacturer's sacrifice on account of tremendous overproduction" appears so often in the advertisements of so-called bargain radio receivers. The dealers realize that the phrase, whether true or not, is a potent sales point.

But there is a vast difference between a legitimate case of overproduction and the much more frequent condition that arises when the manufacturer turns out a large number of sets in an effort to clean up his stock of old parts and raise cash for further operation. The latter type of set often is merely an obsolete chassis mounted in a fancy cabinet. To the eye, the set is good, but what might be called the hidden value, which comes from careful workmanship and accuracy in adjustment, simply is not there. Or a lot of cabinets dropped from the line of one manufacturer may be fitted to the left-over chassis of some other manufacturer. The result is a hybrid that may look well but isn't even worth the low price asked for it. The result is comparable to fitting a 1925 automobile chassis under a more recent body of some other make and calling the combination a new car.

EVEN when a radio set is a legitimate bargain, there are drawbacks that the purchaser should consider. In many cases such sets are sold "as is," and when service is given, it frequently is of a most sketchy nature. Even if good service is given for a specified period—say ninety days or so—sooner or later the owner will have to depend on a near-by dealer who has no interest in the set and may have no specialized knowledge as to how it should be repaired. Furthermore, the question of where to obtain spare parts may prove troublesome, especially if the manufacturer has gone out of business and the set is an "orphan."

When choosing a radio set the prospective owner should consider it in terms of hours of satisfactory reception compared with the original investment, the upkeep, and the possibility of getting quick and expert service. Because a set is cheap in price does not signify that it will prove inexpensive on the basis of cost per hour of entertainment. Many old sets now being sold as bargains are seriously deficient in tone quality, selectivity, and sensitiveness. If it costs a certain sum per hour for inferior entertainment, while the best of entertainment from a modern set would cost only slightly more, then obviously the bargain set is no bargain.

THE radio fan with considerable experience needs no advice to help him choose a bargain set. Because of his familiarity with the various makes and his knowledge of their possibilities, he will know if the set offered is good, and if the price quoted really is low.

When investigating the merits of a bargain radio set, first make sure of the maker's name and the model number. Find out if the manufacturer is still in business and selling modern sets. Check up on the model number to be sure that the set is not misrepresented and that it was made in the year specified, and not a year or two previous.

Note particularly what type of tubes is used. If it is supposed to be a screen grid receiver make sure that it is not a phoney circuit worked with one screen grid tube. Check up on the power tubes used and also the rectifier tube. Avoid any set that uses nonstandard tubes. This means that the set must have type -24 A. C. screen grid, -27 A. C. heater, -71A, -45, -10, or -50 power tubes, and -80 or -81 rectifier tubes. The -26 tube is becoming obsolete, although such tubes undoubtedly will be obtainable for several years to come.

BEFORE the deal is closed the set should be checked for tone quality, sensitiveness, and selectivity against a modern receiver working under the same conditions and hooked to the same antenna.

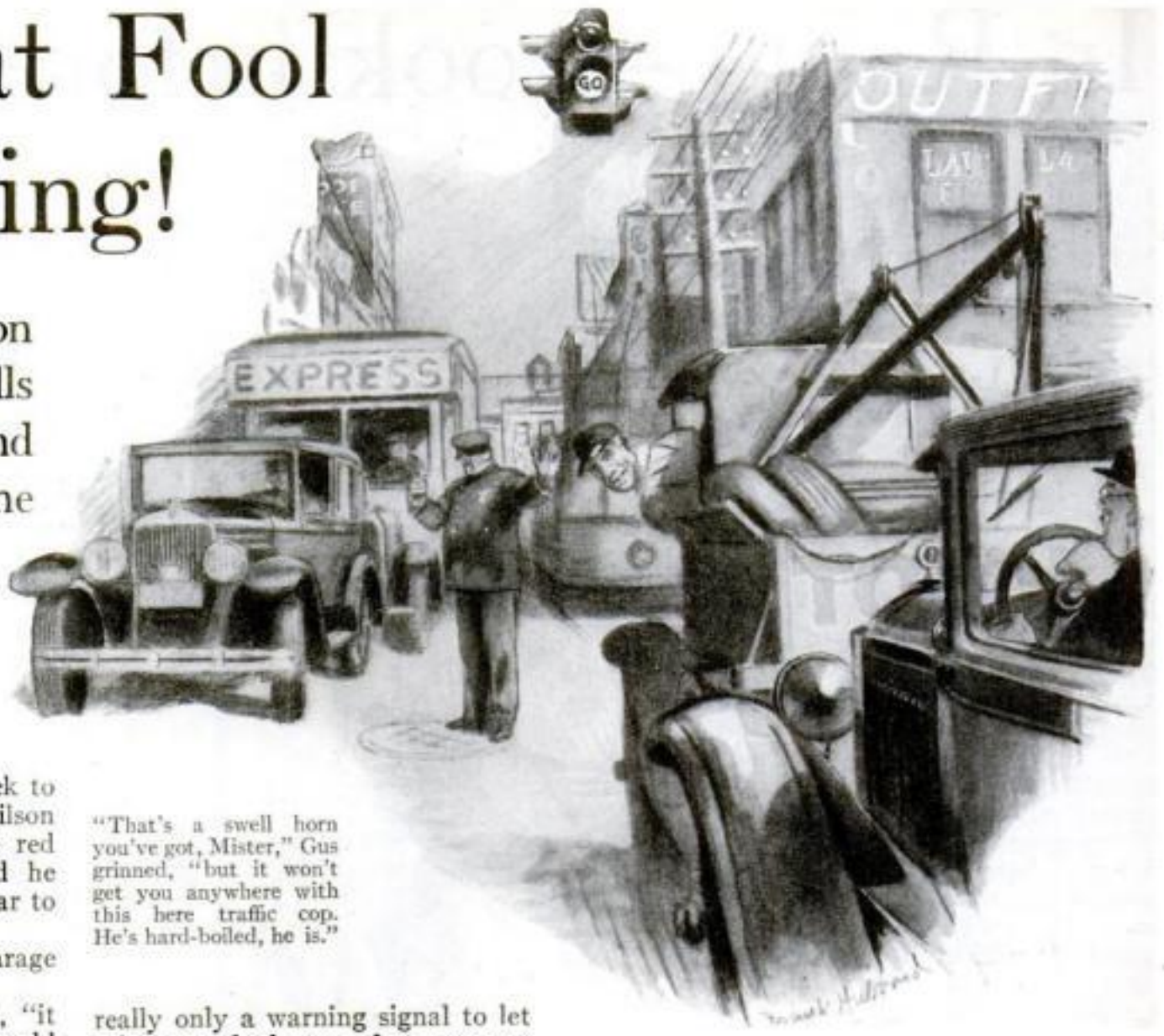
Of course, this discussion of bargain radio sets applies directly to electric type sets. The situation with regard to battery operated sets is entirely different. There are plenty of bargains in battery sets today—new sets left on the manufacturers' hands when battery sets went out of style, and sets that were traded in for modern electric sets.

Since economy of upkeep is an important consideration in a battery operated set, choose one that uses the fewest number of tubes consistent with satisfactory performance. With a good outdoor antenna, a four- or five-tube set will give results as satisfactory as can be had at reasonable expense for battery upkeep.

Stop That Fool Honking!

Gus Reads a Lecture on Use of Horns and Tells When to Blow Them and When to Let Them Alone

By
MARTIN BUNN



"That's a swell horn you've got, Mister," Gus grinned, "but it won't get you anywhere with this here traffic cop. He's hard-boiled, he is."

"THIS is the third trip this week to get odd-sized tires," Gus Wilson grumbled disgustedly as the red light flashed on at a crossing and he brought the Model Garage service car to a halt.

Joe Clark, his partner in the garage business, grinned cheerfully.

"Never mind, old-timer," he said, "it won't be long now before most of the old crocks that use freak sizes go to the junk dealer. It's a good thing not so many sizes are used on the new cars."

Gus merely grunted as he watched for the green light. It flashed on a second or two later, but just as he started to let in the clutch the traffic officer held up his hand to allow another car to make a left turn. The driver in the car behind immediately thumbed his horn button for a series of aggravating toots.

"Must be Honking Harry," Gus snapped to Joe as he stuck his head out to see who was doing the tooting.

"That's a swell horn you've got, mister," he grinned, "but it won't get you anywhere with the traffic cop that's holding up this parade. He's hard-boiled, he is."

Gus forgot the incident until a few days later when a car pulled up in front of the Model Garage.

"Bet you Honking Harry's busted his tooter again," Gus whispered to Joe as the owner of the car approached the two garagemen.

"How about fixing my horn, Gus?" he asked. "Can you do it now? I feel lost without a horn."

"That's how any motorist ought to feel, Mr. Blainfield," Gus agreed, as he lifted the car's hood. "I guess we can take care of you right away."

"A horn is mighty important," observed Blainfield as Gus got out his tool kit and started to take the horn mechanism apart.

"Sure, a horn is important," Gus agreed, "but you don't have to blow it all the time."

"Yeah?" grunted Blainfield. "How else are you going to tell people what to do?"

"That's just the point," said Gus. "A horn isn't to tell people what to do. It's really only a warning signal to let other people know what you are going to do, and to me it's a sign that you are a good driver if you know when not to use a horn as well as when to use it."

"MAYBE so," admitted Blainfield, "but it seems to me that it is always better to blow the horn if there's any doubt about it. Then you are on the safe side."

"Not always," Gus maintained. "There's nothing safe about blowing your horn and expecting that the fellow trying to cross the street is going to stop because he hears you tooting. Maybe he won't, and then if you slam him, the knowledge that you blew the horn is kind of cold comfort.

"To my way of thinking a horn is an emergency signal. If you're a good enough driver you'll handle your car so that the occasions when you'll have to blow the horn are few and far between. Just the other day I made a fifty-mile trip and just for fun I counted the number of times I blew my horn. The total was only three. Once was when a fellow started to cut in on me. Another time was when some kids were playing in the street and that time I blew it while I was still quite a way off so as to tell them I was coming. The third time was to warn a fellow who was backing into the space ahead of me that he was coming back too far."

"I never looked at it that way before," said Blainfield. "Don't you blow your horn when you pass cars? What do you do when you come to a crossing?"

"SOMETIMES I give one quick toot if I have to pass a car and he's too far out on the road," Gus answered, "but I never pass a car at a crossing nor just before a crossing. It's a good idea to give a long toot before you reach a crossing if it's a bad one, but it's a lot safer to slow down so you can stop in time if there is another car coming.

"I don't claim that blowing a horn is always foolish," Gus went on, "but a lot of it certainly doesn't get you anything. The silliest honking is when you get tied up in traffic. The fellow at the head of the line is just as anxious to get on as you are. Blowing your horn doesn't clear the traffic. Of course, there are times when the fellow at the head of the line doesn't notice the green light. One short toot from the car right behind him ought to be enough without the whole line giving an imitation of Armistice Day."

"That's right, too," agreed Blainfield. "While you're fixing that horn can't you make it sound better?"

"What do you want to make it sound better for?" (Continued on page 150)

GUS SAYS—

YOU can't insult an auto driver by telling him his brains are in his feet—if he's wise he'll take it as a compliment. Plenty of brains in your feet will make clutch facing and brake lining last about twice as long as usual. Your right foot ought to know enough to get off the accelerator in time to let you coast to a stop and save wear on the brakes. Your left foot, boss of the clutch, should know enough to let in the clutch gently and not try to control car speed by slipping it. And brains in your feet will make 'em work together when you start the car—right foot keeping the motor running just fast enough without racing and left foot making the motor take the load without stalling.

POPULAR SCIENCE HOME WORKSHOP

Articles on Furniture, Models, Toys, Sporting Equipment, and All Forms of Craft Work—Better Shop Methods—The Shipshape Home

New Ideas for a Racing Flyer

How to Build a Fuselage Model with Sweepback Wings—Has Two Novel Spring Shock Absorbers and a Rudder Regulator

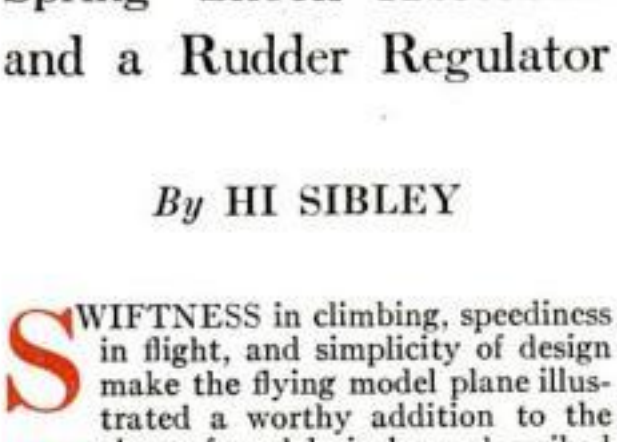
By HI SIBLEY

SWIFTNESS in climbing, speediness in flight, and simplicity of design make the flying model plane illustrated a worthy addition to the many plans of model airplanes described in past issues of POPULAR SCIENCE MONTHLY.

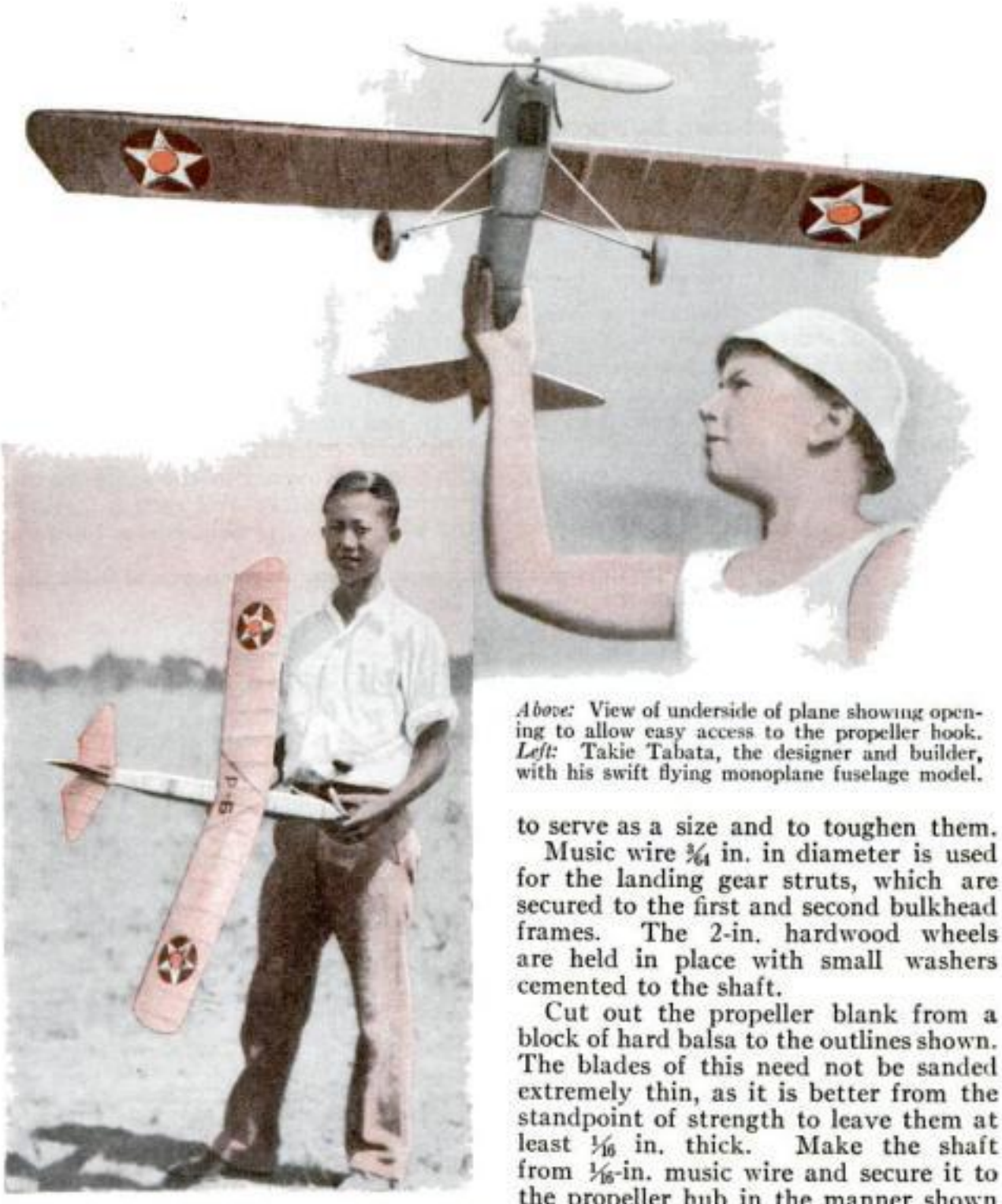
Its designer and builder is Takie Tabata, a fifteen-year-old resident of Pasadena, Calif., who has a long list of record-breaking models to his credit.

The fast little plane shown has made hand-launched flights of 800 ft., and its designer is confident it will do over 1,000 ft.—a very satisfactory mark for a 5-oz. fuselage type ship. On the day the accompanying snapshots were taken, there was an unusually high wind, but the little plane tore into the gale like an angry hornet, veered about gracefully, and came to a graceful landing.

Two new features are incorporated in this model: double shock absorbers on the landing gear and an adjustable fin. To make the shock absorbers, the music-wire struts at the bottom are given four turns around a spike, forming a coil spring which serves as an auxiliary shock absorber; while two strands of rubber supported by a V-shaped, celluloid yoke under the fuselage act as the main absorbers. This arrangement prevents many a crack-up that would otherwise result from a hard landing.



Adjustable fin and stabilizer unit. The stabilizer is held with a rubber band around the fuselage.



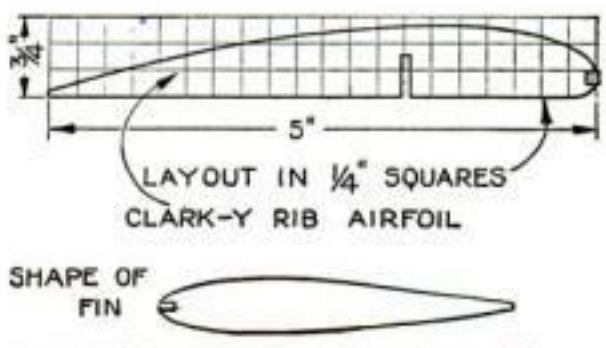
Above: View of underside of plane showing opening to allow easy access to the propeller hook. *Left:* Takie Tabata, the designer and builder, with his swift flying monoplane fuselage model.

The fuselage is built up as indicated in the drawings on page 76. It is made entirely of 1/8 in. square, hard balsa longerons and bulkhead frames, with 1/16-in. soft balsa on the sides for formers and 1/16-in. hard balsa fairing strips placed in the formers.

The nose, which is made from a 1¾ by 2¼ by 2½ in. block of balsa, is rounded with a bulge at the propeller shaft bearing. The front ends of the longerons are set in mortises so that they will be flush with the surface of the nose block, and the rear ends are drawn together and secured to balsa blocks, through the center of which passes an aluminum tube. The latter serves as a socket for the dowel axis of the tail fin or rudder. All of the fuselage frame members should be given a coat of model airplane dope to serve as a size and to toughen them.

Music wire 3/64 in. in diameter is used for the landing gear struts, which are secured to the first and second bulkhead frames. The 2-in. hardwood wheels are held in place with small washers cemented to the shaft.

Cut out the propeller blank from a block of hard balsa to the outlines shown. The blades of this need not be sanded extremely thin, as it is better from the standpoint of strength to leave them at least 1/16 in. thick. Make the shaft from 1/16-in. music wire and secure it to the propeller hub in the manner shown in the double scale diagram. A short piece of brass tubing soldered to a nut and fastened with an ambroid type of cement to the balsa nosing is used for the shaft bearing. Note that this bearing must be in line with the rear hook. The dummy exhaust pipes are made from



Detail of the wing rib construction and drawing showing the general shape of the fin ribs.

The swift little monoplane can either be launched by hand or made to take off from the ground.

3/16-in. aluminum tubing and attached to the nose block.

The sweepback wing requires careful workmanship to get each half properly lined up. Note that the trailing edge is made of basswood, the leading edge of hard balsa 1/8 in. square, and the single intermediate spar of 1/16 in. thick soft balsa. A razor blade clamped in a wooden handle makes a handy tool for shaping the Clark-Y wing rib sections.

A curved strip of bamboo joins the ends of the leading edges together, and short pieces of heavy music wire are used to join the intermediate spars and the trailing edges.

Where there is likely to be any strain, bind all joints with thread after applying the cement. Sheet balsa 1/16 in. thick is used for the wing, stabilizer, and fin tips. The leading edge of the wing at the center should be raised 1/4 in. higher than the trailing edge by the interposition of a small piece of balsa. The wing should tilt up at an angle of approximately 4°; trial, however, will determine the proper adjustment.

THE fin, which weighs less than 1/8 oz., has sheet balsa ribs and 1/16 by 3/16 in. leading and trailing edges. A 1/16-in. maple dowel, placed in back of the center, serves as an axis for the steering adjustment. A short piece of light music wire is cemented to the forward end of the bottom of the first rib to engage in the holes of the aluminum plate, which is cemented transversely to the top longerons. The small pinholes in the plate can be drilled with a short section of music wire ground flat at the end, the wire being chucked in a hand drill so that only about 1/8 in. extends beyond the jaws. This type of drill is also useful for drilling small holes in many jobs where hard metal is involved.

Bend a 1/16 in. square strip of bamboo to the shape of the trailing edge of the stabilizer. To bend bamboo, hold it a few inches above a candle flame, shiny side down, and shape it gradually with the fingers. The leading edge is made from strips of 1/16 by 3/16 in. hard balsa joined at the center with a bent strip of bamboo. A maple dowel 1/16 in. in diameter serves as a spar through the center. The stabilizer unit is secured to the fuselage by means of a rubber band looped over in the usual manner.

Extreme care must be exercised in the application of the Japanese rice paper. Cover one side of one half of the wing and stabilizer at a time. Apply a thin coat of glue or bamboo cement to the top edges of the end ribs and then to the leading and trailing edges, but do not apply adhesive to the intermediate ribs. The glue can best be spread with the forefinger. Have a piece of the rice paper ready, an inch larger all around than the wing; draw it taut from rib to rib (end to end), and press it down on the glue, and tighten it crosswise. The underside of the wing is covered in the same manner except that the central section between the wing halves is covered on top only, being left open at the bottom where it rests on the fuselage. The fin is covered in substantially the same manner.

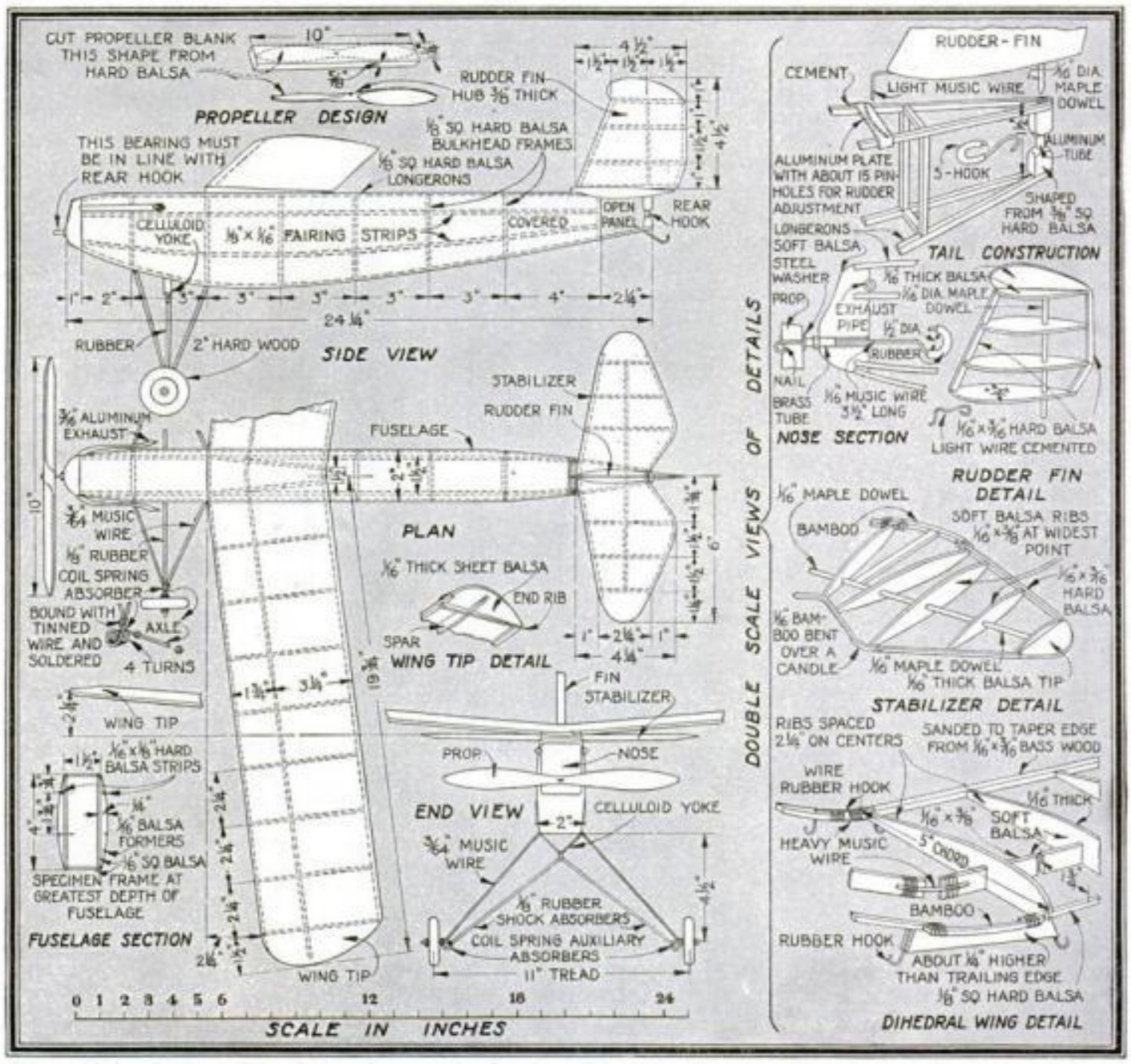
Separate pieces of paper will be required for each side of the fuselage. An open panel is left at the bottom just back of the nosing, and on both sides at the tail.

When all of the paper is in place and the glue has dried, apply a coating of wing dope with a soft brush. Do this in dry weather, and use a half-and-half mixture of dope and lacquer thinner.

While the wing should be located somewhere back of the second bulkhead, its exact position is determined by trial.

PUT twelve strands of 3/16-in. flat rubber bands in place on the hook, detach the rear S-hook, pull the rubbers out to three times their normal length, and wind the motor with a mechanical winder. With a four-to-one winder, from 125 to 130 turns can be taken with a reasonable degree of safety. Mechanical winders can be purchased from model airplane supply dealers, but a serviceable type is nothing more than a hand drill with a strong wire hook placed in the jaws. An egg beater also can be used.

The plane can be launched from the ground or the air. If the plane dives, move the wing forward a slight distance, and vice versa. If the plane shows a tendency to nose into the wind, a slight adjustment to the rudder pin will probably remedy the trouble.



Assembled scale views of the plane and perspective drawings of the important parts. The wing is double-covered and has a dihedral of 2¼ in. as well as a 2¼-in. sweepback. Note especially the construction of the coil spring shock absorbers.

A Card Table by Hepplewhite

Measured Drawings of One of His Most Famous Designs with Suggestions for the Construction of an Accurate Copy

By FREDERICK J. BRYANT

When placed against the wall with the pivoted leaf raised as shown, the piece serves as an attractive console table.

BEFORE starting to build a reproduction of the Hepplewhite card table illustrated, the amateur cabinetmaker is certain to ask a few questions. How much will it cost to make? What is the commercial value of a table like this if purchased in a furniture store? What is the value of the fine antique table this drawing represents?

If the right hinges are selected, and mahogany, white holly inlay, and mahogany veneer are used, the cost should not exceed ten dollars. The commercial value will range from forty to seventy dollars, depending on how well the table is made and on the quality of the fittings used. A genuine antique table of this design generally sells for about two hundred dollars.

The materials needed are: 2 pieces of mahogany ¾ by 18 by 36 in. for the top, 4 pieces of mahogany 1⅝ by 1⅝ by 27½ in. for the legs, 1 piece of pine 3½ by 10 by 34¾ in. for the apron, 1 piece of maple 1⅝ by 3½ by 35 in. for the gate arm, 1 piece of pine ¾ by 3½ by 35 in. for the gate arm backpiece, 1 pair of card table hinges, 2 yds. of ¼-in. white holly inlay, 18 yds. of 1/16-in. white holly inlay, and 1 piece of mahogany veneer 6 ft. long and 3¾ in. wide.

Names of dealers handling inlay, veneer, and hardware can be obtained by sending a self-addressed and stamped envelope to the Information Department of POPULAR SCIENCE MONTHLY.

Even with limited experience in making furniture, one need not hesitate to begin this project. The inlaying and veneering are the only details which might cause some concern and, fortunately, in this particular case neither process is difficult.

The line inlays of white holly are glued into grooves made with a specially prepared marking gage. The writer uses an ordinary gage with the point filed screw driver shape. The grooves should be cut the same width as the inlay and about 1/16 in. deep. Grooves across the grain can be cut with a sharp knife and a square. Apply hot glue to the inlays and force each strip into the groove by rubbing with a knife handle or a piece of slightly rounded hardwood.

An inlay used on curved surfaces may be dampened slightly to prevent splitting. Each corner strip should be mitered. A stiff-backed safety razor blade makes an ideal tool for this operation. All inlays and veneers should be glued two or three days before being scraped and sandpapered.

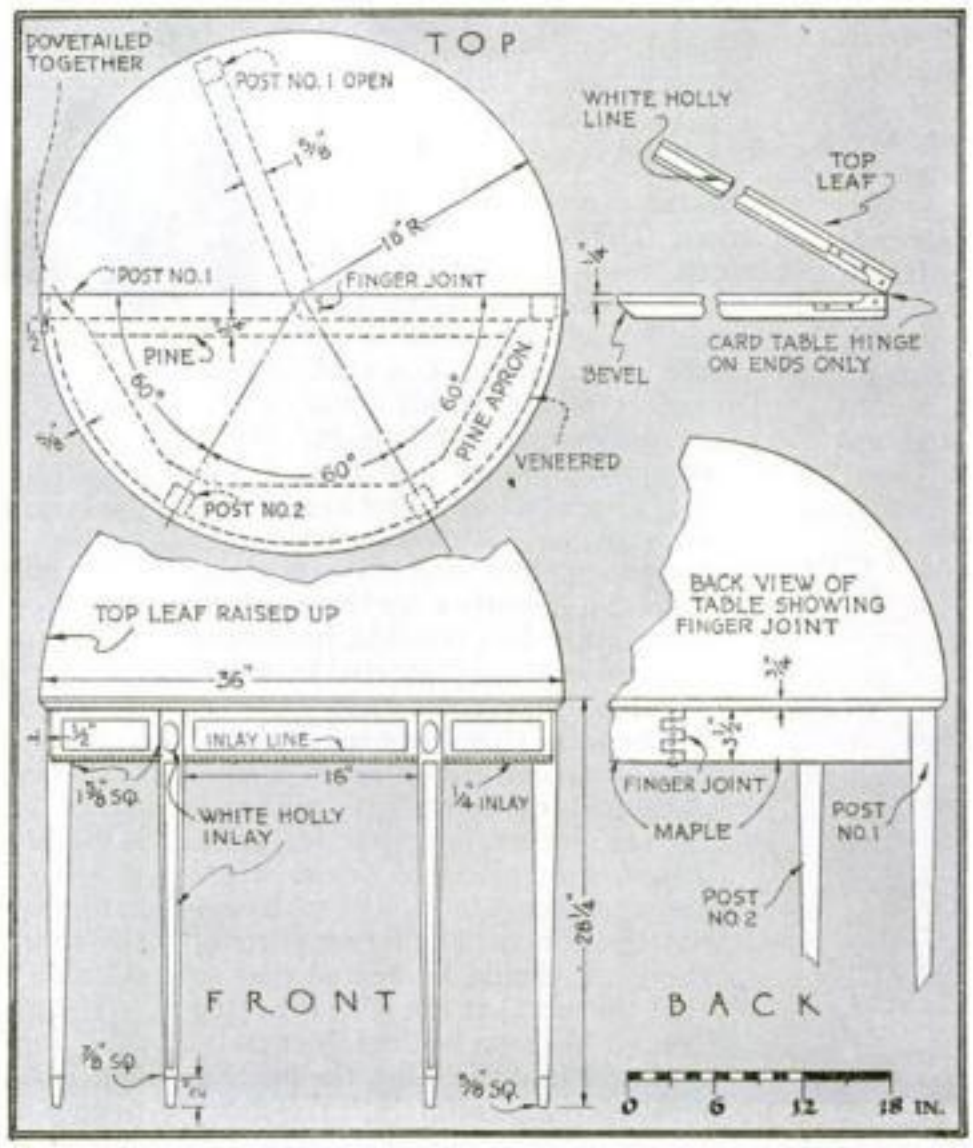
The apron or curved rim which joins the front is made from a heavy piece of white pine. The outside surface, which is rounded, is covered with a thin sheet of veneer. A ¾-in. bent rim can be used, but the heavier piece makes it easier to fasten the legs in place.

The rim is veneered in one piece before the legs are fitted. One method of accomplishing this is to dampen the veneer, glue it to the rim, and then rub it with a piece of hardwood. The other method is to use cauls, or forms, which in this case can be the scrap pieces of wood left in cutting the curve of the apron. The veneer is dampened to make it pliable and is glued in place in the usual way. Paper is placed between the veneer and the cauls to prevent sticking. For further details on veneering and inlaying, see P. S. M., Mar. '29, p. 90, and Feb. '27, p. 88.

The top is made up in two halves, the upper leaf having a square edge while the lower one is beveled under (see drawing). The four legs should be made of solid mahogany and should be inlaid on their outer surface with a line of white holly.

Leg No. 1 is not fastened to the table frame but to a gate arm which has a finger joint near the center. This leg supports the top leaf when it is lowered.

In finishing, use a weak solution of potassium bichromate made by dissolving a few crystals in water. Do not try any ordinary wood stain unless you protect the holly inlays with shellac. After the table is dry, sandpaper lightly with 4/0 sandpaper and then apply one wash coat of thin orange shellac. If a wood filler is to be used, as is now customary with mahogany, it may be advisable to put on a second coat of shellac to cover the inlay thoroughly. The work is then ready for two coats of varnish. If filler and varnish are not to be used, from four to six coats of thin shellac will probably be necessary. For further information on finishing inlaid mahogany, see P. S. M., Mar. '27, p. 122.



Measured drawings of an inlaid Hepplewhite card table made about 1790. Note the construction of the movable leg, backpieces, and finger joint.

Secrets of Silver Soldering

Choosing the Materials—Binding and Clamping the Joints—Ways to Apply Heat and Clean the Work

By EDWARD THATCHER

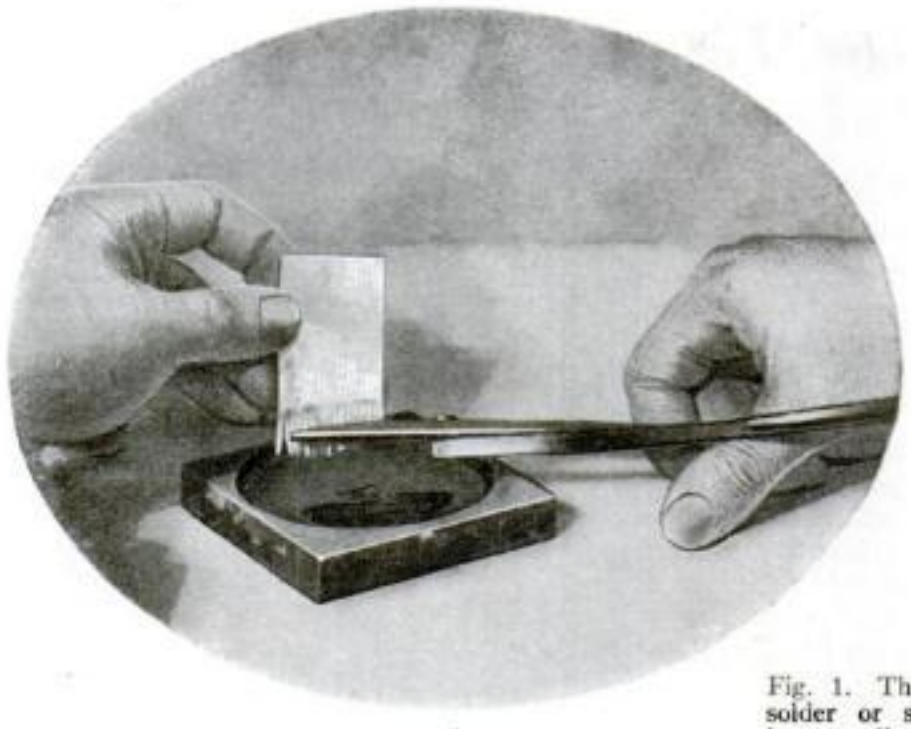


Fig. 1. The sheet silver solder or spelter is cut into small, square pieces.

FEW operations are more important in decorative metal work than hard or silver soldering.

Silver solder is made up of silver and brass in varying proportions according to the melting point desired. It is furnished in wire and sheet form, the sheet usually being preferred. Gold solder is an alloy of gold and copper or of gold and silver. Pure gold may be soldered with 14-karat gold, but the special gold solders are generally used.

Since brass melts more easily than copper, large work in copper is usually soldered or brazed with brass or with spelter made up of copper and zinc in varying proportions. Small pieces of decorative work in copper or brass, however, are usually soldered with silver solder. Iron or steel may be brazed with common sheet brass or silver solder.

In the process of silver soldering, the metal at the joint is first scraped bright and clean, and the joint is tightly bound with heavy iron wire or clamped with iron clamps. Several typical joints are shown in Fig. 4.

Powdered borax, mixed to a creamlike paste with water, is applied as a flux to both sides of the joint. For small work, such as jewelry, lump borax ground up with water on a slate stone is used as a flux. The lump borax can be obtained from jewelers' supply houses or can be made by melting ordinary household borax in an iron ladle and allowing it to cool.

Fig. 2. Homemade soldering turntable with charcoal banked about the work.

The silver solder, which must be perfectly clean, is cut into 1/32-in. or smaller pieces (see Fig. 1). These bits of solder are then covered with wet borax and are applied with tweezers along the seam directly over the crack or joint and, when possible, inside the work so as to be protected from the direct heat of the flame.

The work thus prepared is placed on a charcoal fire or set in a suitable bed of refractory material, such as cinders, lump pumice, coke, asbestos, or pieces of brick. Heat the work very slowly at first to dry out the borax. The larger parts of the work should be heated first so that the metal at the joint is heated evenly. As soon as the solder melts and runs into the joint, the heating must stop immediately. The flame should never be directed on the solder or spelter because it will burn off the protective flux and oxidize the solder. As in similar operations in soft soldering, the molten metal always will run to the hottest part of the work; hence the importance of heating both sides of a joint evenly.

Silver soldered or brazed work is usually cleaned after soldering by dipping it while hot into an acid pickle and leaving it there long enough to remove the borax scale. Small work, such as jewelry, is placed in a copper pan filled with acid pickle and the pan heated until the pickle boils up about the work.

If both hard and soft soldering are used on the same piece of work, the hard soldering should be done first, as the soft solder will not withstand much heat.

It frequently happens that more than one joint is to be soldered on a piece of work. Unless both are to be soldered at the same time, the first joint should be protected with a thick coating of yellow ochre mixed with water. Be careful, however, not to get any on the second joint.

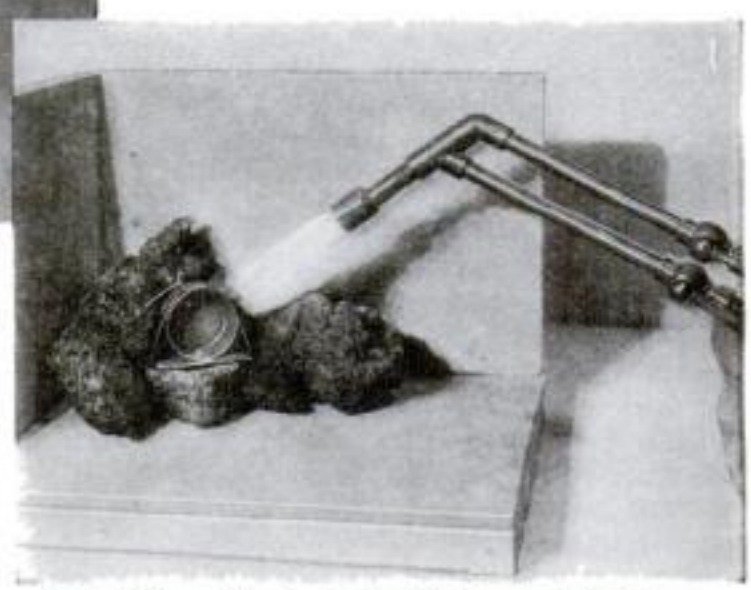


Fig. 3. Using a blowtorch in soldering work that is supported and surrounded by charcoal in a soldering box.

If charcoal is used, the fire is built in a small forge, an iron bowl, or a basin of tin with holes punched in it (Fig. 2). The work is placed on the fire and the charcoal banked up about it to confine the heat where it is most needed. A pair of bellows is used to blow up the fire here and there to force the heating. Frequently a gas or gasoline torch is used in conjunction with the charcoal fire. When using charcoal, suitable ventilation should be provided.

The method of using the blowtorch and soldering box is shown in Fig. 3. The box is lined with tin and thick asbestos to confine the heat. If much work is to be soldered, a revolving stand such as shown in Fig. 2 is of great advantage.

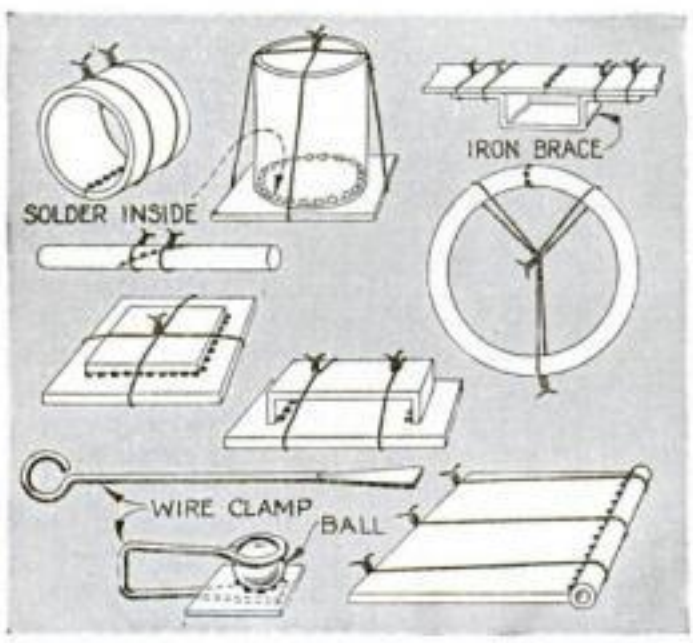
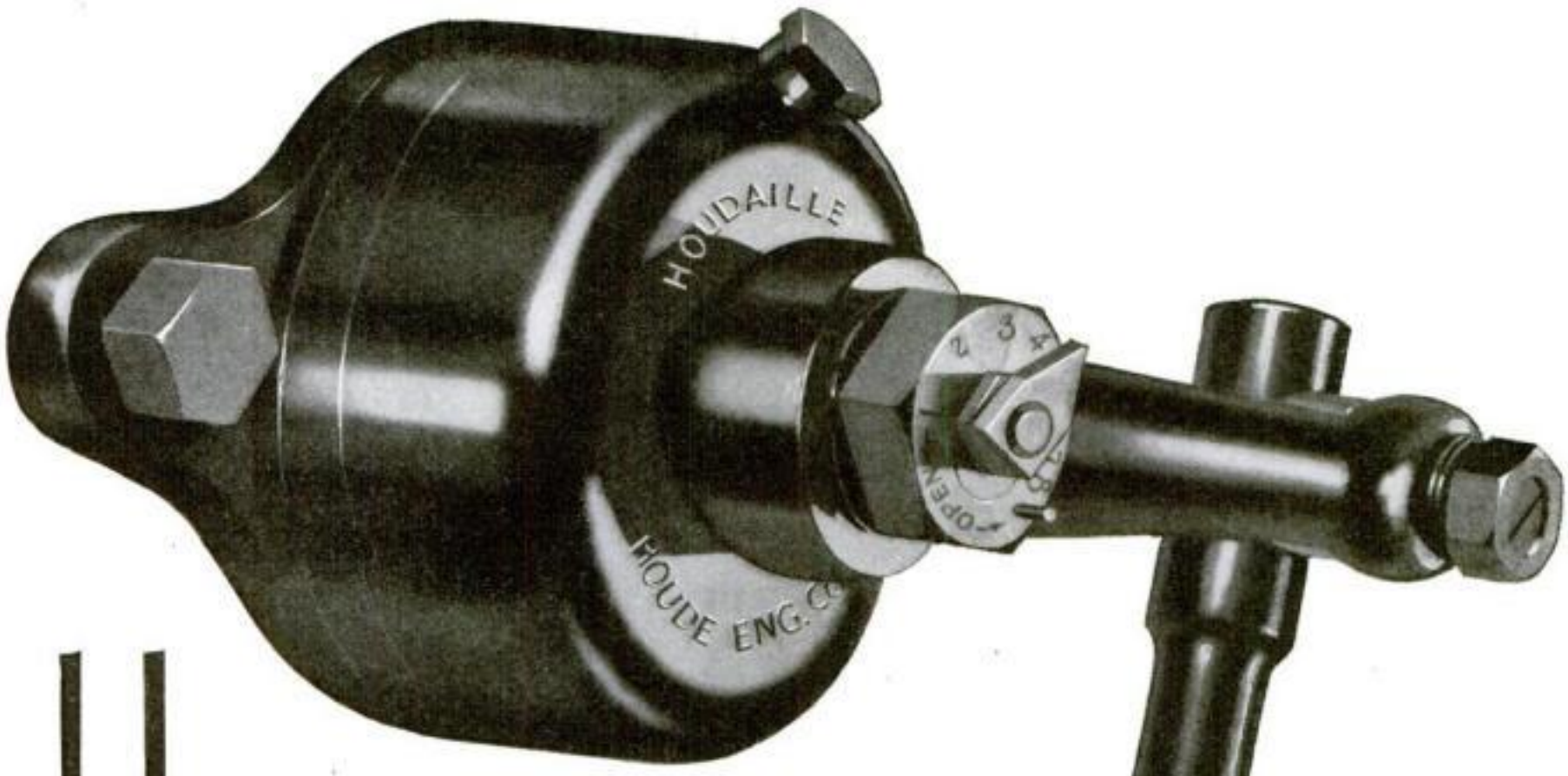


Fig. 4. Typical joints ready for hard soldering or brazing. Note how the bits of solder are placed.



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Hints on Hanging Curtain Rods

How to Drape Windows of Odd Shapes—Making Sash Look Wider or Narrower—Draw Cords

By

KENNETH B. MURRAY

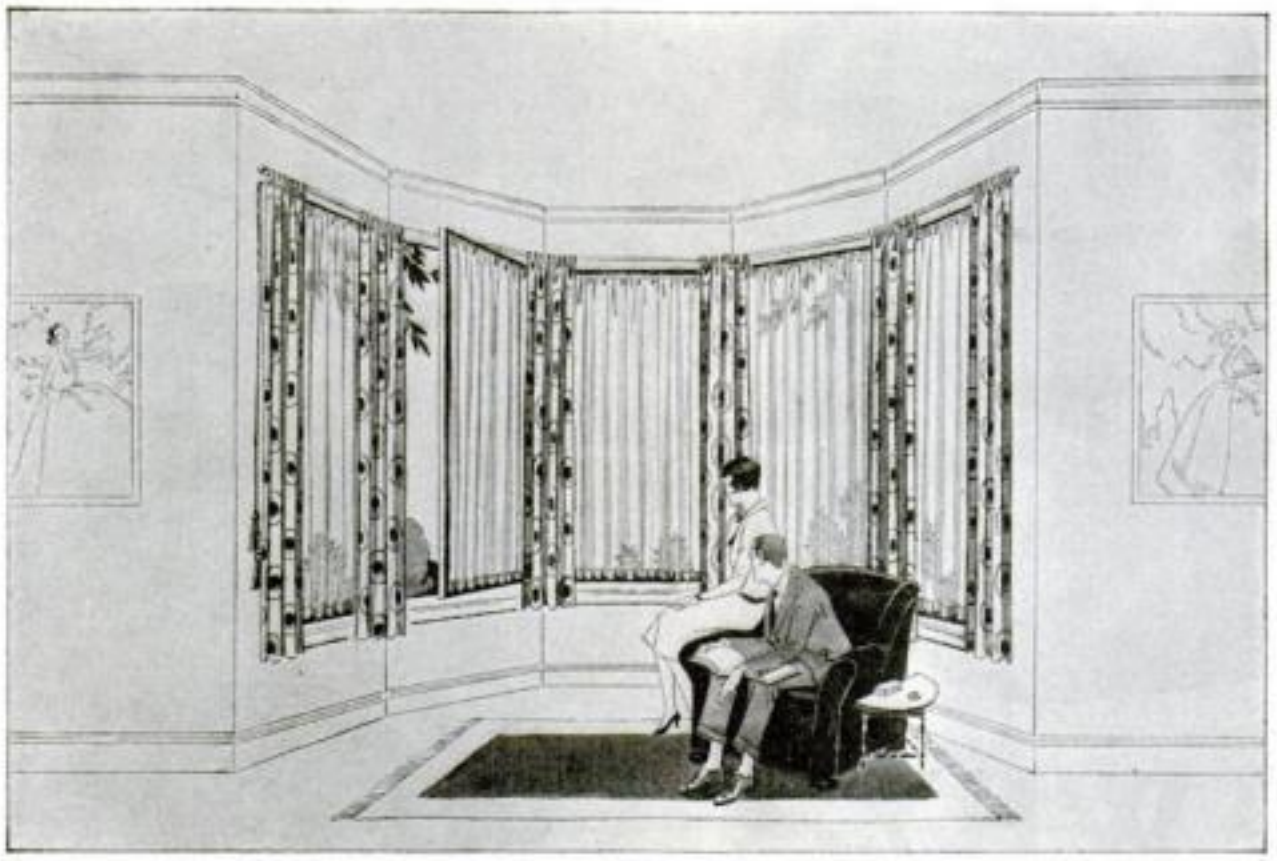

Fig. 1. Draperies, carefully chosen and properly hung, go far to decorate any room. In this bay window, the side drapes are supported by continuous rods and the inner curtains by individual sash rods.

HOME owners often find it difficult to hang curtains and draperies with that professional competence required by modern high standards of interior decoration. English, Dutch, Colonial, Spanish, and other types of small house architecture test one's ingenuity in arranging curtain rods at odd-shaped windows.

After all, the decorative effect of draperies depends largely upon how the rods are placed. Round-top windows and windows that seem too narrow, too wide, or too short and high present individual problems, but the solution in each case is simple if the following methods are studied. They represent the everyday practice of experienced professional decorators.

One thing that helps the home owner is the fact that it is now possible to select curtain rods and brackets to fit almost any style of window architecture, no matter how unusual or bizarre in design.

Windows with Curved Tops. Windows that are half oval or half circular at the top should be fitted with rods that follow the curve faithfully. Regular flat rods can be purchased already curved, but it is also possible to obtain a narrow, solid sash rod, about ¼ in. wide, which can be readily curved in the workshop with the aid of a paper pattern.

To make the required template, use a sheet of newspaper (or several sheets placed together) and pin it to the top of the window. Carefully outline the curve at the middle of the casing with a pencil. Cut on this line with scissors and lay the pattern on a workbench. Drive nails 1 in. apart in the bench top, following the curve of the pattern, as shown at *G*, Fig. 4, page 82. Bend a length of the narrow rod about this form so that it matches the curve perfectly.

A straight piece of the same rod is used at the lower part of each half circle, as at *H*. Substantial brackets support each end, and a screw hook is used at the top. The brackets and fixtures can be obtained from curtain rod dealers; in fact, certain fittings are sold especially for attaching curved rods to the window casings.

Two correct methods of draping this type of window are shown at *A* and *B*, Fig. 4. In the first method the side drapes are fastened with hooks over the curved rod, with inner curtains on a flat rod. In the second method, curtain material is shirred on the curved rod in a sunburst effect. A regular single or double flat rod is fastened to the casing flush with the bottom of the half circle for supporting the side drapes and inner curtains.

Doors with oval-shaped glass are frequently found in houses having round-top windows. A flat sash rod is placed at the top, extending the full width of the glass. If the swinging of the curtain on opening the door is an annoyance, another sash rod may be placed at the bottom, with the curtain shirred between them.

Steel Casement and Recessed Windows. Windows that are recessed in the wall, as well as those having casements of steel, are more of a problem. In both cases there is only the plaster wall on which to affix brackets, and plaster is not suited for driving screws. One way of meeting this difficulty is to drill and chisel holes in the wall and drive substantial wooden plugs into the holes, so that they will provide a solid support for brackets. Painted to match the wall, they are invisible. Another method is to drill small holes for each screw and set into them special fiber plugs sold for this purpose.

A more recently developed method is to use special bracket holders, either purchased or made from heavy sheet steel. These are screwed directly to the recessed window frame, or in the case of steel casements they may be bolted through holes drilled in the metal, as at *C*, Fig. 4. On recessed windows they project outwards for the depth of the recess and then are bent over flush with the wall. Holes are provided so that curtain rod brackets may be securely bolted in place.

Devices of this kind are an improvement over fastening

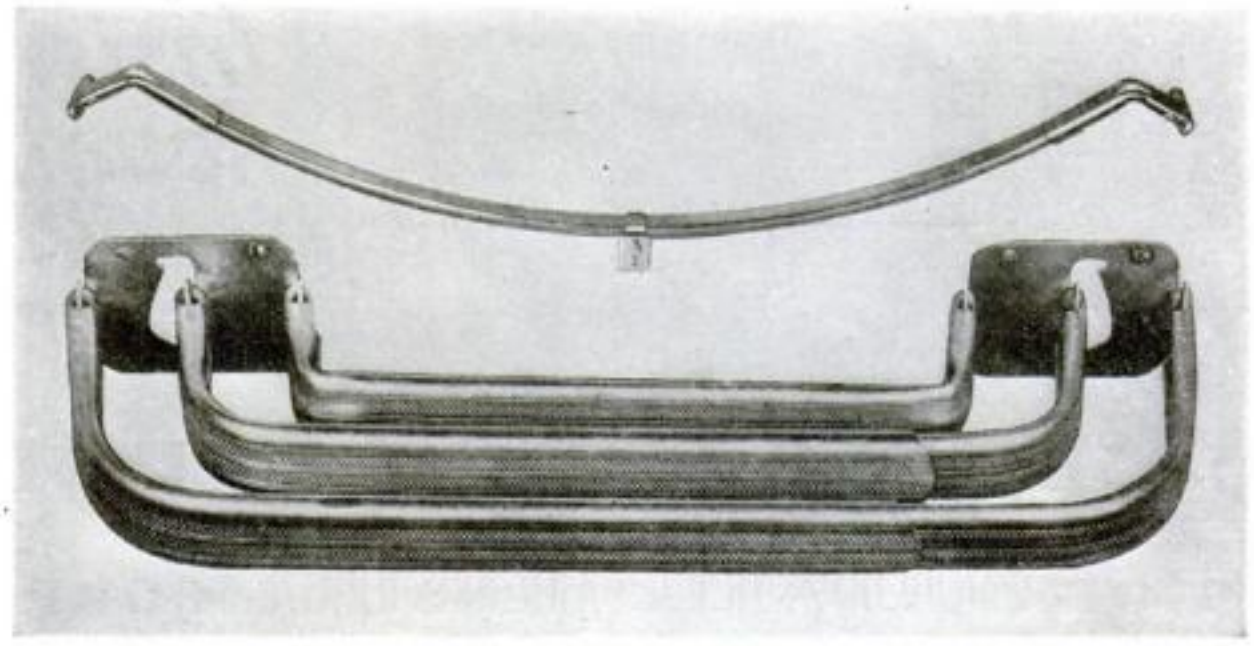

Fig. 2. Curved rods can be obtained like that in the upper view to fit windows with bent glass such as are found in towers and circular bays. A standard triple rod is shown in the lower view.

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the rods inside the recess, because the drapes hang against the wall at the sides and do not obscure the view or curtail light. This arrangement is, of course, intended only to take care of draperies; small flat sash rods should be screwed or bolted directly to the casements, top and bottom, for the shirring of light curtain material.

Windows with steel casements may swing in or out. When they swing out, it is more practical to leave the casements without curtains and hang the latter inside on a second rod underneath the drapery rod. When they swing in, it is better to use draw curtains, the mechanism of which is described later.

Sometimes an old-world effect is carried out by using tiers of small casement windows. To enhance the effect, place small sash rods at top and bottom of each individual window. In this event the drapery rods are omitted.

Double and Triple Windows. Regular flat rods, with extension sections if necessary, are used at multiple windows. The only difficulty is that the rods will sag in the middle, especially on triple and larger windows, unless intermediate supports are used. These are merely screw hooks with extra long shanks.

Whether to use single, double, or triple rods depends upon the effect desired. A single rod will support the inner curtain, and the draperies and a valance can be sewed to the hooks and hung on the same rod. Triple rods (Fig. 2) permit the inner curtain, drapes, and valance each to have a separate rod. Set 1 in. apart in this way, the draperies have the appearance of miniature stage hangings.

Then there is the problem of bay windows and solarium windows (Fig. 1). Special bay-window rods are made to take care of any style; it is also possible to use rods curved "flatwise" to fit the windows (Fig. 2). The latter are more practical for continuous draw curtains. Indeed, it is desirable in the solarium or sun room to use continuous rods for the length of each side, with supports where necessary. The continuous rods are sold in 12-ft. lengths.

Odd-Shaped Windows. Where there are small windows at each side and above a fireplace, use smaller rods of the same type as those at the larger windows.

Long narrow windows and short wide windows can be altered by adroit placing of curtain rods. When a window is long and narrow, place the brackets at the extreme outside of the window casing and as near the wall as possible; in extreme cases, on the walls themselves (Fig. 4 at *F*). This brings the drapes farther apart and gives an impression of width as at *E*.

The opposite tactics are used with short wide windows; the brackets are placed inside the casing at the extreme top so that drapes will hide a considerable portion of the width (*I* and *J*).

In older houses windows with oblong transoms are sometimes found, usually with colored squares of glass. The lower part should be draped independently in the usual manner, and two sash rods placed at top and bottom of the transom with curtain material shirred on them. The same treatment is given door transoms.

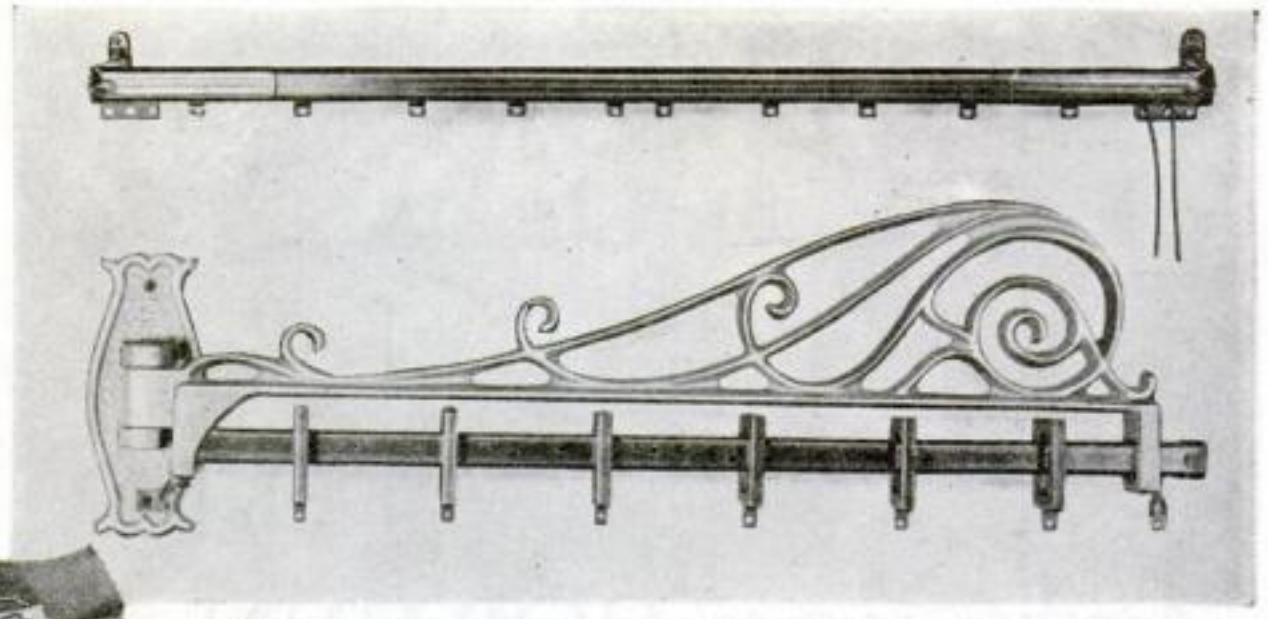

Fig. 3. A straight rod with draw-cord equipment; a new type of wrought-iron side-drape hanger with slides for drawing curtains apart; and a curtain hook (at the left).

Draw-Cord Equipment. It is in the hanging of curtain rods with draw-cord equipment that home workshop experience serves the amateur decorator well. Rods come equipped with the necessary cord, weights and slides, as shown in Fig. 3.

A good quality of cut-to-measure flat rod should be used. This can be cut with a hack saw to exact lengths. Do not place it in a vise for cutting, as the pressure tends to squeeze the flanges together, making it useless for draw curtains. Fasten the rods to the window casings with the usual brackets and elbows at the ends. Place a support in the exact center of each length, if necessary.

The slides are made of metal and pass freely in the groove formed by the flanges on the back of the rod. Both cords and pulleys are concealed inside the rod, making the operation simple and smooth.

In computing the correct length of a draw cord, measure the length of the rod, add three quarters the height of the window (top to bottom of casing), and double the result. On the ends of the cord, tie draw cord weights by threading them on the cord and knotting the end. If these are of metal, they should be of the kind with a rubber bumper ring, which will save marring the wall and casing.

An easy way to attach the draw curtains is by means of hooks. These slip into buttonhole tape sewed to the curtain, and in turn hook into holes in the slides. With this type of equipment, draw curtains operate perfectly, without the clatter of the old-fashioned brass rings. All the mechanism but the rod is concealed.

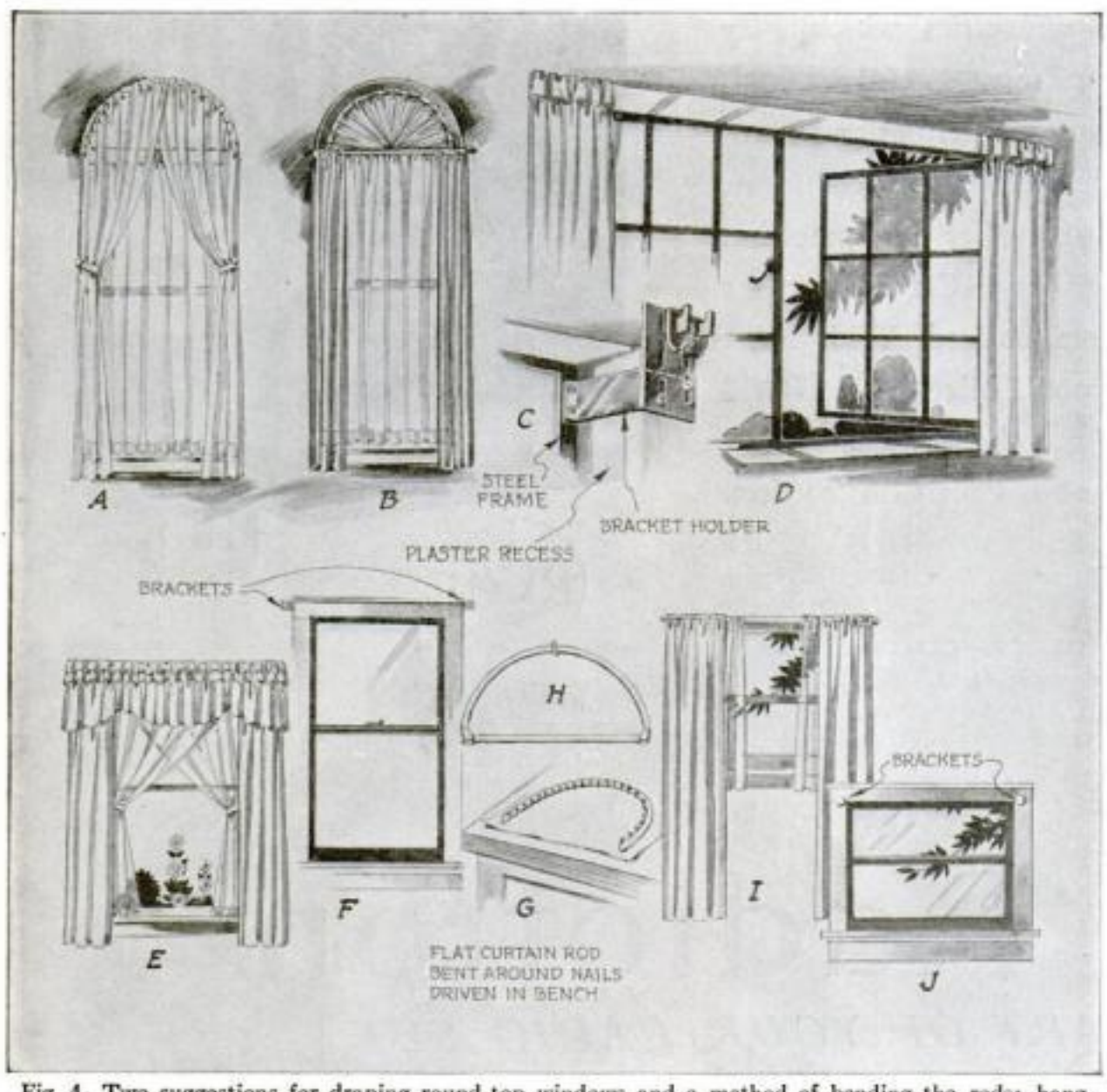

Fig. 4. Two suggestions for draping round-top windows and a method of bending the rods; hanging draw curtains at a recessed steel casement window; how to make windows look wider or narrower.

Don't Let *SPRING-SLAP* Toss You in a Blanket!

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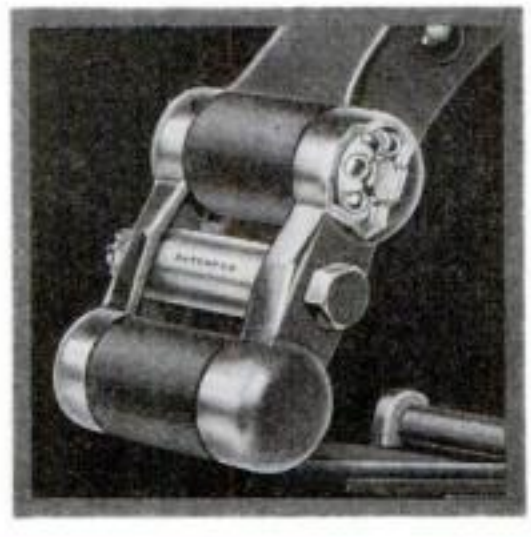

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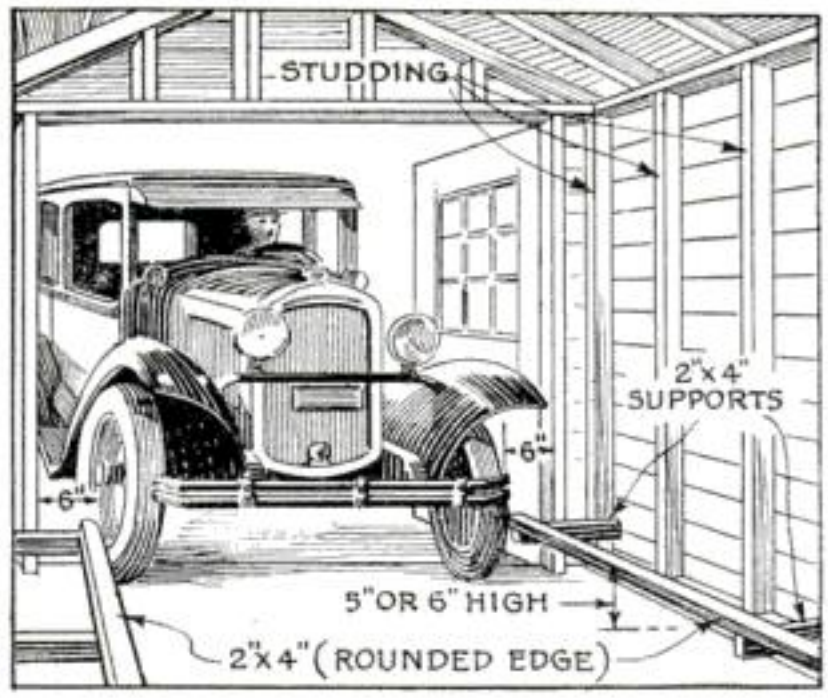

Fig. 1. Guide rails fitted in garage will keep car from the side walls.

BROKEN fenders and mashed hub caps often are caused by collision with the side walls in a narrow garage. Figure 1 shows how to prevent such trouble by fitting guide bars that will keep the car away from the walls or door jambs in driving in or backing out.

A couple of lengths of two-by-fours can be cut and mounted as shown in the illustration. Since it is desirable that the tires should not rub against the guide bars any more than necessary, place them just as close to the side walls as will insure keeping the mudguards, running boards, or hub caps from striking anything. If placed flat on the ground the two-by-fours will not prove effective because the tires will have a tendency to ride over them. On the other hand, if they are placed too high and the car is fitted with wire spoked wheels the spokes may be injured. Consider these factors when fitting them. Be sure to round off the edges of the two-by-fours against which the tires will rub and see that they are planed and sandpapered smooth. Also note that the guiding two-by-fours should be fastened to the supporting sections so the latter are one quarter to one half inch back of the edge of the guiding bar.

Curing Poor Idling

THE effective opening past the butterfly valve, to allow the motor to idle at a slow speed, is surprisingly small. After the car has been in use for several years, the shaft on which the butterfly is mounted and its bearings become worn. The result is that the butterfly never closes to the same position twice running; in addition, a considerable amount of air leaks through

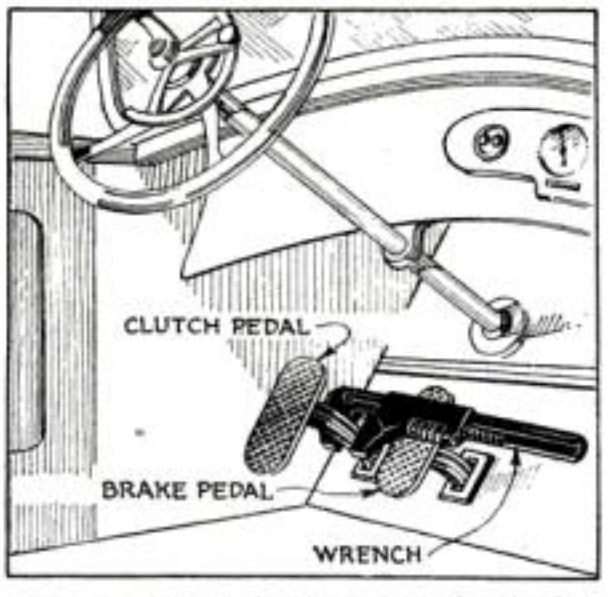

Fig. 3. The wrench, clamped to the clutch, holds brake pedal while adjustment is made.

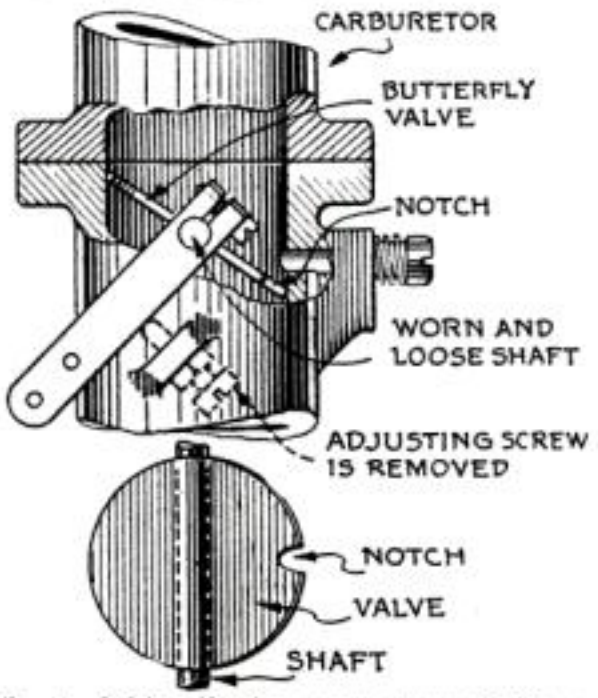

Fig. 2. With adjusting screw removed, file a notch in the butterfly valve to govern the idling speed of the motor, when the bearings admit air.

around the shaft bearings. A simple way to cure this trouble is to remove the adjusting screw entirely so that the butterfly closes tight. File a small notch in the edge of the butterfly valve as shown in Figure 2. This notch should be filed in the side of the butterfly valve on which the low speed nozzle is located and the size of the notch will govern the idling speed.

Wrench Holds Brake Pedal

A NOVEL and ingenious method of holding the brake pedal while adjustments are being made on the brakes is shown in Figure 3. By setting the wrench so that it is fairly tight on the clutch pedal shaft, it will hold the brake pedal at any desired position so that the point is easily found where the brakes first begin to take hold.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to H. C. McAninch, Durant, Okla., for his suggestion for method of holding brake pedal depressed (shown in Figure 3, at the left).

Curing Leaky Valve Guides

THE operation of a gasoline motor is not affected by leaky exhaust valve guides unless the wear is so bad that the valves do not properly seat, but leaky inlet guides cause irregular running at slow speeds and make it impossible to get the motor to idle smoothly. Figure 4 shows a way to eliminate this trouble. A light spring is fitted over the valve stem and a felt or leather washer is fitted on the stem with a hole that will just allow the valve stem to slide. It is a good idea to place a thin metal washer between the spring and the felt, although this washer is not shown in the illustration. The light spring will keep the washer pressing against the top of the guide and prevents air leakage and the consequent spoiling of the mixture.

This suggestion should prove useful on old cars where the expense of new valve guides is not justified.

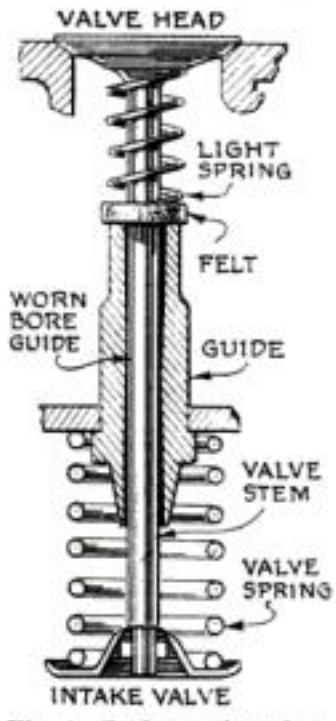

Fig. 4. Spring and washer on inlet guides stop leaks.

Wire Removes Broken Axle

WITH some types of rear axles it is difficult to remove the broken end without taking off the differential housing cover. Figure 5 shows how to accomplish this job without disturbing the cover. A loop is formed on the end of the wire as shown. The wire, of course, should be so stiff that the loop can be slipped down over the end of the axle. The slip noose arrangement will afford a sufficiently good purchase on the end of the axle to pull it out.

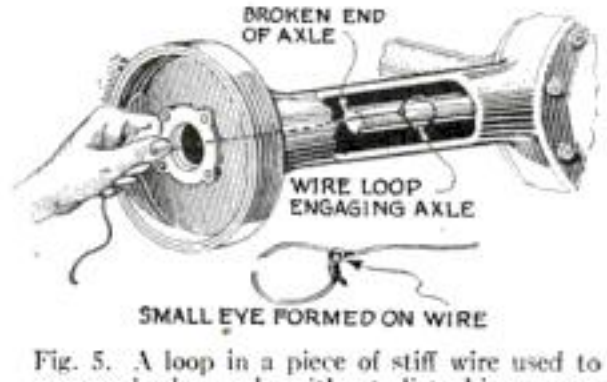

Fig. 5. A loop in a piece of stiff wire used to remove broken axle without disturbing cover.

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Mount Washington, N. H.
From Toll House to crest of Mount Washington, America's steepest accessible mountain, in 14 minutes and 49 3/5 seconds. Broke record by 2 minutes and 10 2/5 seconds.

Columbus to Marietta, O.
114.5 miles in 2 hours, 5 minutes and 40 seconds, bettering old mark by 12 minutes and 20 seconds.

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840 miles in 18 hours and 59½ minutes. More than an hour faster than the Twentieth Century Limited.

New York to Miami
1,451 miles in 24 hours and 20 minutes. Beat Miamian Limited by 6 hours and 51 minutes. Average 59.6 m.p.h.

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17.5 miles from Toll House to Camp Alice in 35 minutes and 35 seconds, clipping 5 minutes and 25 seconds from the record.

St. Louis to Kansas City and return
240 miles from St. Louis to Kansas City in 4 hours and 3 minutes. Back to St. Louis from Kansas City in 3 hours and 59 minutes.

Dallas to El Paso, Tex.
687 miles in 12 hours and 54 minutes, lowering old mark by 1 hour and 44 minutes.

Los Angeles to Phoenix, Arizona, (Desert Derby)
892 miles in 17 hours and 47 minutes. More than 4 hours faster than the train time.

Mount Diablo, California
Double round trip up Mount Diablo. 46.4 miles, covering 1,172 turns, in 1 hour, 34 minutes.

San Francisco to Los Angeles
412 miles in 7 hours and 32 minutes, beating his own record by 1 hour and 25 minutes.

Salt Lake City to Los Angeles
765 miles in 14 hours and 57½ minutes. Broke record by 1 hour and 19½ minutes.

Pike's Peak
Six consecutive round trips up Pike's Peak without a stop. 150.28 miles in 4 hours and 25 minutes.

Continental Divide, Mont.
4.4 miles across main Rockies to the summit of Continental Divide and return in 18 minutes flat, averaging 14.66 miles per hour in second gear.

Butte to Anaconda, Mont.
46.8 miles in 37 minutes and 36 seconds, averaging 74.68 miles per hour, 75.7 miles per hour from Butte to Anaconda.

Great Falls to Butte, Mont.
180 miles in 3 hours and 56½ minutes. Clipped 46½ minutes from old record.

Ogden to Salt Lake City
34.2 miles in 30 minutes and 17 2/5 seconds, averaging 67.8 miles per hour. Clipped 6 minutes and three-fifths of a second from old record.

New York to Los Angeles
3,260 miles in 69 hours and 31 minutes, beating by 8 hours and 29 minutes the best time the journey can be made via the crack Twentieth Century and the Chief. Motor not stopped once.

Caring *for a* Circular Saw

How to Set, File, and True Up the Teeth—Pointers on the Use of Bench Machines in the Construction of a Telephone Stool

By

WILLIAM W. KLENKE

Fig. 1. How a hammer and an iron disk are used to obtain the necessary set.

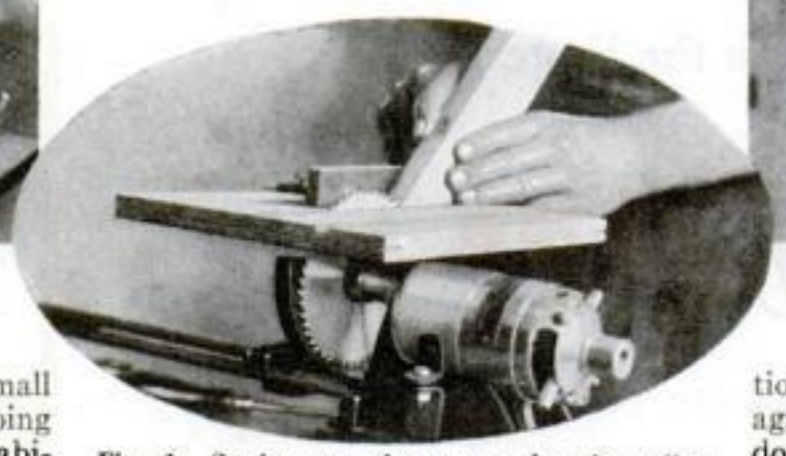


Fig. 3. Sawing out the groove for the spline after the miters for the corners have been cut.

Fig. 2. A vise for use in sharpening can be made from two ¾-in. pieces of wood.

WHEN properly used, a small circular saw is capable of doing the greater part of your cabinetwork. For a saw to give maximum efficiency, however, the blade must be in first-class condition. Dullness of any cutting tool is not only a detriment to fine, accurate work, but a handicap to the worker as well. For, strange as it may seem, a dull saw is more likely to cause bodily injury than a sharp one.

There are two main steps in the sharpening of a saw. The first is to give the teeth "set" or clearance, and the second is to file the teeth to sharp, uniform points.

Setting the Saw. Obtain a special circular saw setting stake, or get an iron disk that is ½ in. larger in diameter than your circular saw blade and have a slight bevel machined on the top to correspond to the amount of set the blade requires. Have a hole and slot made in the center so that the saw can be revolved and also moved toward the edge. On this anvil every other tooth should be bent to one side as shown in Fig. 1. The blade is then turned over and the process repeated.

Filing the Saw. A circular saw vise can be made from two pieces of wood ½ in. thick, 1 in. less than the diameter of the saw blade in width, and 15 in. long. Make one end of each piece semicircular in shape and bore a hole in the center of each circular end. Glue a strip of wood just a trifle thicker than the saw blade at the bottom end of one piece of the vise to keep the jaws parallel. The saw is placed between the boards as in Fig. 2 and is held in place with a bolt.

If the blade is a rip saw, file square across every other tooth with a triangular file; then reverse and file the remaining teeth from the opposite side. Apply equal pressure on all teeth and count the strokes so as to keep all of the teeth uniform. A crosscut saw is filed at an angle of about 60° instead of 90°.

After repeated filings, it becomes necessary to true up the teeth—that is, to make them uniform in height. This can be done by inserting the blade in the saw, bringing the teeth up until they are very slightly above the table, and then cautiously and carefully touching an oilstone against the saw as it revolves. This is done before the setting and filing operations.

The telephone stool illustrated in this article is a companion piece to the cabinet described in the preceding article in this series (P. S. M., April '30, p. 75).

Step No. 1—The Stock. On the jointer (planer) dress all stock. On the circular saw, rip the pieces to width, allowing 1/16 in. for planing; plane to gaged depth and cut to length.

Step No. 2—Top Frame. Work out the caning slots with a groover or with the circular saw and then cut the miters for the corners.

Step No. 3—Grooving for the Splines. Hold the top pieces as shown in Fig. 3 and groove for splines.

Step No. 4—Turning. Carefully turn the legs and stretchers to the design shown in Fig. 4 and sandpaper while the stock is in the lathe.

Step No. 5—Cleaning Up. Sandpaper all parts smooth.

Step No. 6—Assembling. Glue temporary ears on the four top-frame pieces and assemble (see P. S. M., Nov. '29, p. 90). The body of the stool is assembled in two operations. Assemble two legs and the correct rail and stretcher; then, when the glue is hard, complete the assembly.

Step No. 7—Cleaning Up. Remove excess glue and sandpaper with No. 0 and No. 00 sandpaper.

Step No. 8—Finishing. Finish the stool to match the cabinet as suggested in the preceding article (P. S. M., April '30, p. 76).

Detailed instructions for caning were previously published (P. S. M., Aug. '29, p. 120).

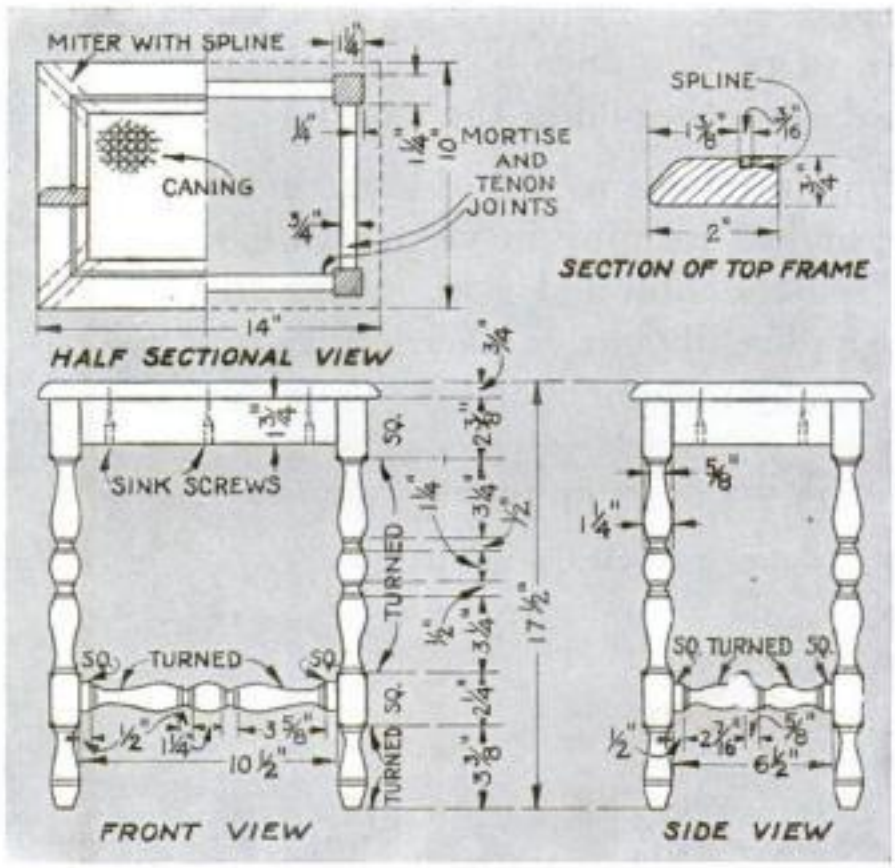
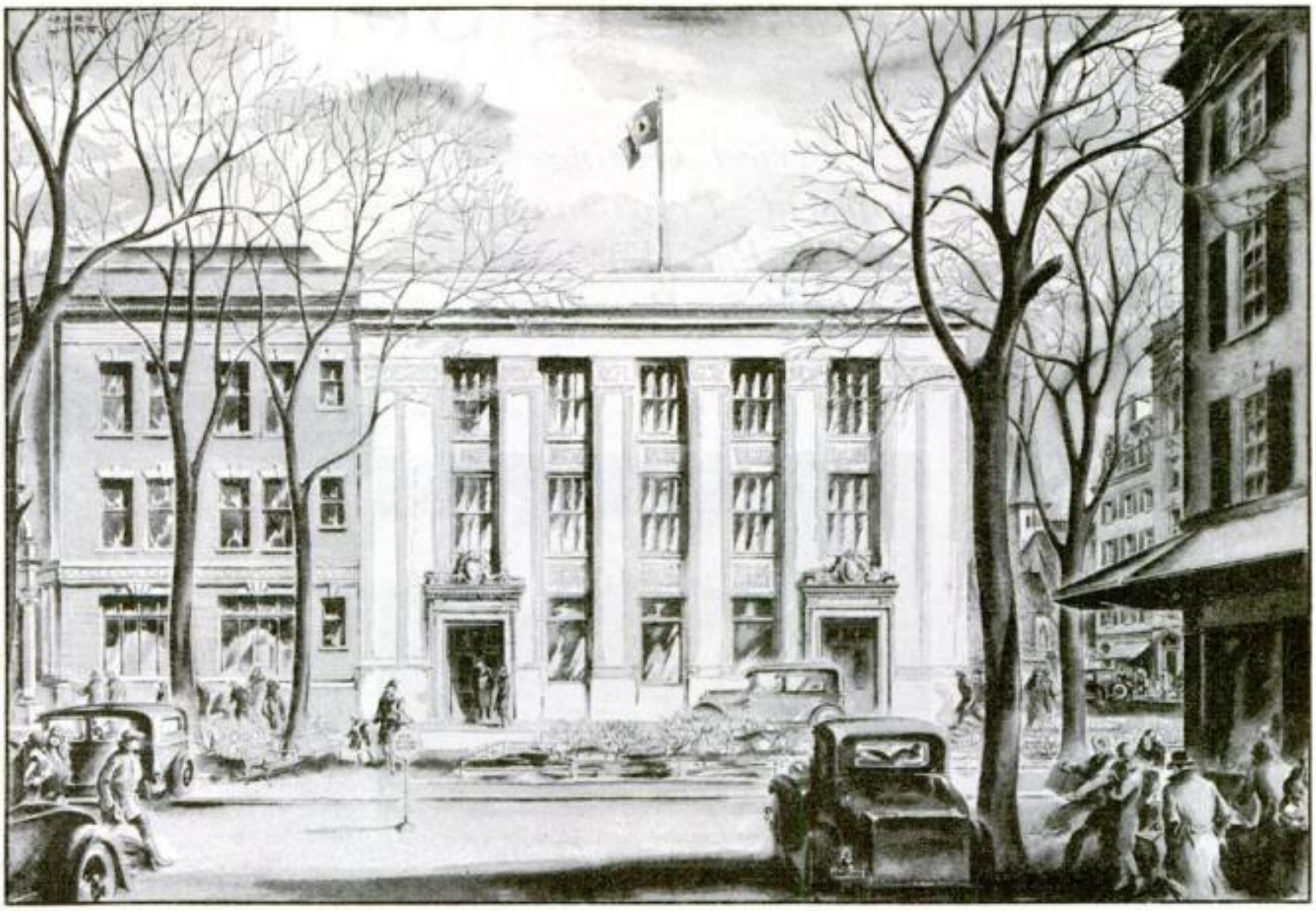


Fig. 4. Assembly views of the telephone stool and a cross section of the top frame showing how the caning is held in place with a spline.



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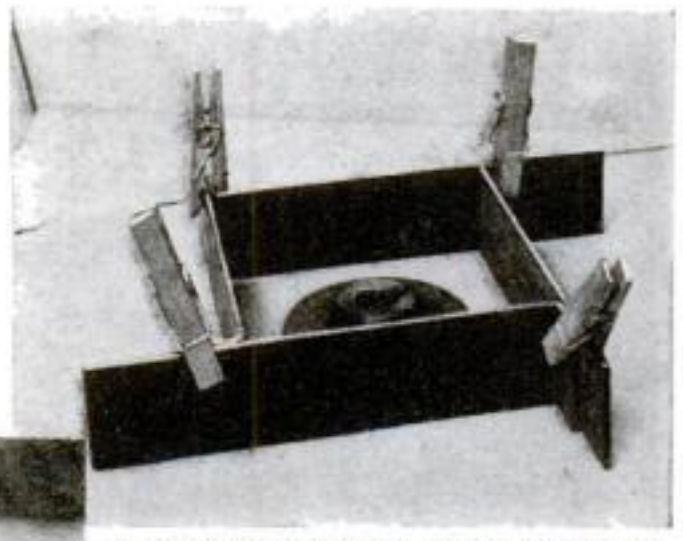
Plaster-Molding Soft Metal

How to Make Smooth, Perfect Castings Without Special Equipment—Preparing the Patterns—One- and Two-Part Work—An Asbestos Mixture—Hints on Pouring

By WARREN N. CRANE

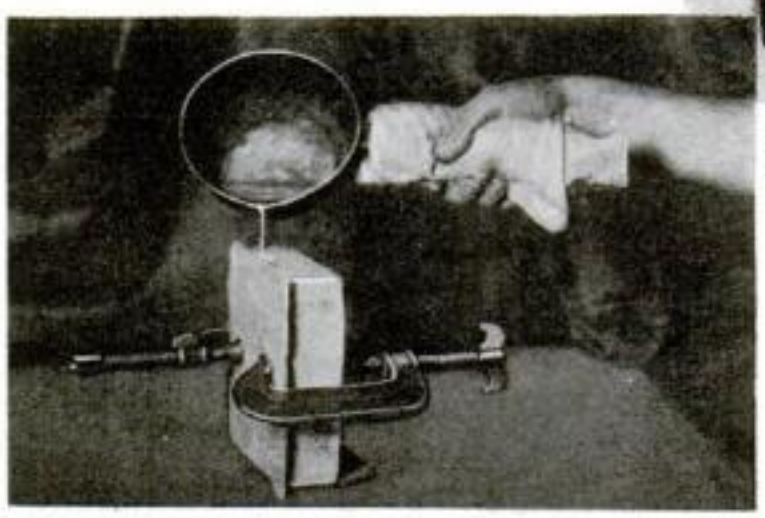


An adjustable metal form can be made from four metal plates and as many wooden clips.

BY THE use of plaster of Paris for molds, the process of casting soft metals can be brought within the range of the average home workshop. The process is simple and inexpensive.

The pattern, from which the mold is to be made, may be of almost any material that will hold its shape long enough for the plaster to "set"; even wax or plastic (modeling) clay will serve the purpose.

In the actual molding, the pattern, which should be smooth and have a good draft or taper to facilitate removal, is placed on a smooth flat surface such as plate glass and fastened with a bit of beeswax to prevent movement or "floating" when the plaster is poured on. Any undercuts should be built up with modeling wax so that the pattern will come from the mold freely, with as little hand relieving as possible.



The mold is covered on the open side with a metal or asbestos plate, which is held in place with C-clamps.

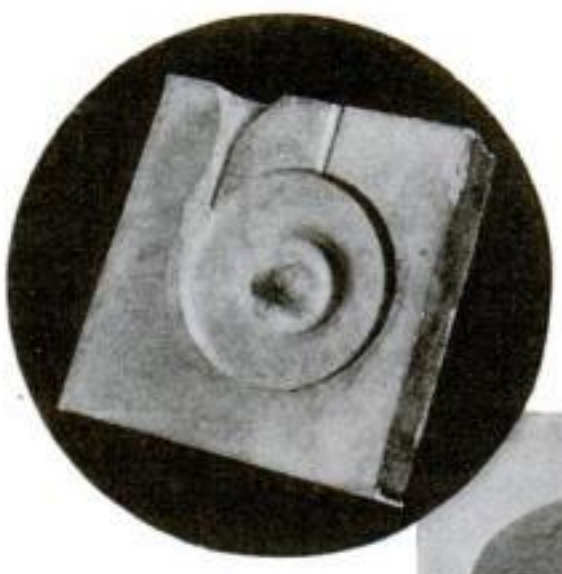
High-grade plaster of Paris or dental plaster will serve for ordinary work, but if more than one or two castings are to be made from the same mold, it is best to use half plaster and half powdered asbestos.

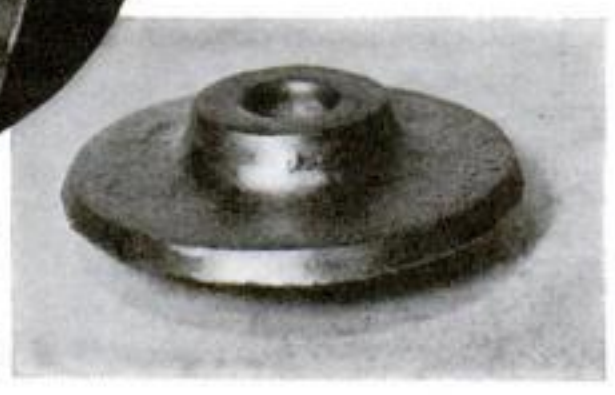
The table at the right shows the approximate quantities required to make a mold of any given size. The figures will, of course, vary to some extent with the quality of plaster used, so it is well to take the required amount of water and add plaster (or a mixture of plaster and asbestos) until the batch reaches the consistency of molasses. The figures for the plaster are useful, however, because they enable you to judge with reasonable accuracy how much to have on hand. Where a very smooth mold is required for making a number of castings, the addition of from 10 to 15 percent of flake graphite is an advantage.

How Much Plaster to Mix

Volume of Mold Cu. in.	Water Fl. oz.	Plaster Oz. Av.
1	.42	.56
2	.84	1.12
3	1.26	1.68
4	1.68	2.24
5	2.08	2.80
6	2.52	3.36
7	2.94	3.82
8	3.36	4.48
9	3.76	5.04
10	4.16	5.60

A form should be placed around the pattern to hold the plaster till it hardens. This form must be deep enough to allow the plaster to cover all high parts of the pattern by at least ¾ in., or even more for the larger size molds. An adjustable metal form, as shown, is convenient for this purpose, because any size within its limits may be quickly set up. This type of form is also removed readily when the plaster has set. The mold, however, must be allowed to become dry and hard before any attempt is made to remove the pattern.





Above: A pouring gate and a venthole to allow the escape of gases and air must be cut in the mold. *Right:* The casting as drawn from the mold. The draft on the pattern is what makes removal possible.

If the pattern has one flat side so that only a one-part mold is required, channels are cut in the mold for the pouring gate and air vents.

A flat metal or asbestos plate is clamped against the open side so that the casting may be poured on edge as shown.

If the pattern is of a more complicated form and requires a mold of two or more parts, the procedure is the same except that provisions must be made on the parting surface for dowel pins or other means of keeping the pieces in register.

After the pattern is removed, the parting surface from the impression to the edges of the mold should be given one or two coats of shellac. This prevents the parts from sticking together. When the shellac is dry, the pattern is put back in place, the dowel pins are inserted, and the form is again placed around the part of the mold already made.

More plaster is now poured in to form the opposite half of the mold. When this has become dry, the pouring gate and ventholes are cut out as before, and the mold is ready to receive the metal.

A few points to be remembered in the making of molds of this type are:

First: The mold must be bone dry and should be as hot as possible before the metal is poured. This prevents the presence of air bubbles and moisture and the possibility of having the hot metal spatter.

Second: The pouring gate should lead to one side of the mold so that the metal runs into the cavity without turbulence.

Third: The metal should be hot enough to pour freely, but should not be so hot that an excessive amount of oxide is formed. As the metal is poured, hold back the scum.

NOTE: This article was scheduled originally for the March issue, but was withdrawn in a last-minute change of schedule. It did, however, appear in a few of the first copies printed. In republishing it in this issue, the editor has been governed by the fact that many readers have expressed special interest in this particular subject.

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A Toolmaker's *Tips on* Drilling, Boring, Reaming

By HECTOR J. CHAMBERLAND

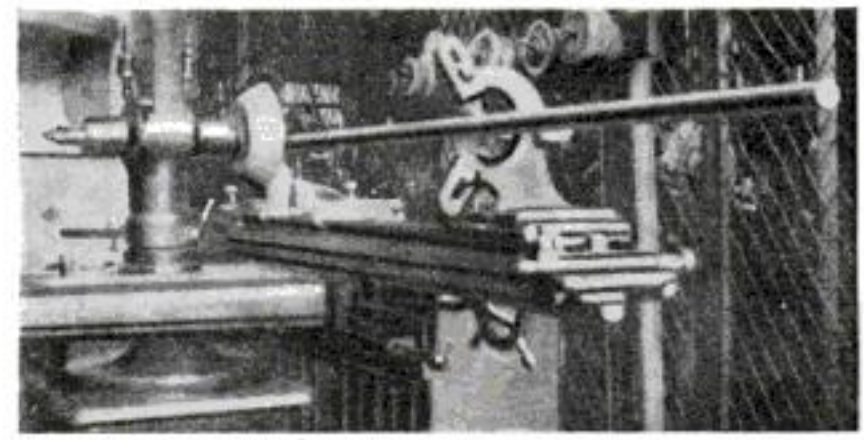

Fig. 1. Grinding a 72-in. line reamer on an ordinary tool grinder. Reamers of this type are economical for use in jobbing shops.

IN MACHINE tool construction, in punch, die, and fixture work, and in the jobbing shop, boring is one of the most important—and expensive—operations. No good results can be expected without the proper tools, and these must be in first-class condition.

Before the details of the principal boring operations in jobbing shops are taken up, the twist drill deserves a word or two. How often have you noticed two chips evenly circling out of the grooves when drilling? You didn't have to hang on the lever of the drill press! That was because you had a drill with a correctly ground point (Fig. 3).

Drill points on sizes over ¾ in. should be machine-ground, but that does not mean they always are. Any operator is likely to touch up a drill several times while running through a certain number of pieces, in most cases doing the grinding free-hand. To give the drill point the cutting qualities it should have, a gage should be used. There are on the market suitable gages for this purpose, and every machinist should have one.

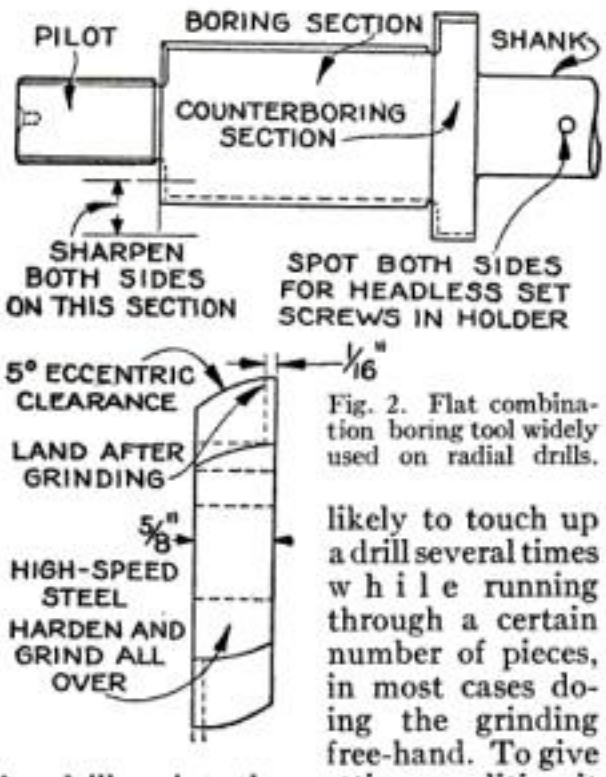

Fig. 2. Flat combination boring tool widely used on radial drills.

Three things are important: the angle of point, the lip clearance, and the correct speed. Cutting lips not of uniform size will produce oversize holes and cause excessive wear on the lip doing the work. Lack of clearance will throw a heavy load on the machine, split the drill, and very often cause a breakdown. Too much clearance will weaken the cutting edges, cause them to dig in suddenly, and perhaps cause injury. The wrong speed may cause almost any inconvenience.

The standard drill point should have an included angle of 118°, a lip clearance of 12° or 15°, and a chisel-point angle of 130°. For drop forgings the approved included angle is 125°, the lip clearance 12°, and the speed 198 R.P.M.; for cast iron and machinery steel, 118°, 15°, and 387; for brass, 118°, 15°, and 540; for copper, 100°, 15°, and 540. These angles and speeds are based on the results of a series of tests that were run on one inch diameter drills.

In drilling brass, stone the face of the cutting edge of the drill to reduce the angle of the spiral.

When cored holes are to be drilled in casting, the operator should, of course, use a four-lip drill, if one is available.

To turn from drilling to boring, there is little difference, so far as general principles are concerned, whether the work is done on the boring mill or the milling machine. With a large casting on the boring mill, the operator has to keep in mind the lining up of the bores, whether these are to be fitted with bushings for a spindle or used for stationary parts. To line up the bores successfully he depends on the line reamer.

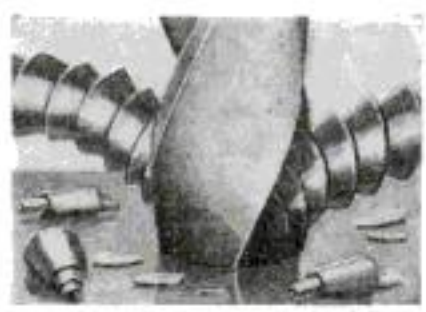

Fig. 3. Chips from a well-ground drill—a preliminary guarantee of an accurate hole.

THE rear bore is usually bored to size and the front bore .003 in. undersize. The job is lined up by using a bushing in the rear to fill the gap between the diameter of the bore and that of the reamer body.

Line reamers, if made as in Fig. 4, are economical. The flutes should be made deep enough so the blades may be shimmed for any desired diameter. Fitting the blades as shown is advisable, for the reason that if the blades are given a hard drive, the entire job may be jammed when resetting is attempted. An allowance of .015 in. should be made for grinding, as for any other reamer; this should be done cylindrically.

Very often the length of the reamer is out of the range of the grinding machine; in this case the work is done on a cutter grinder as in Fig. 1. A straight arbor of the same diameter as the reamer body is mounted between the centers, and the center rest adjusted. The headstock is removed and the rest is bolted at the extreme end of the table. The reamer is indexed in the usual way; the grinding is done with a cup wheel.

If the reamer is first ground cylindrically, it should be relieved to within .005 in. of the edges; if finished entirely on the cutter grinder, it should be made .002 in. oversize, to allow stoning .001 in. from each cutting edge. A 3° clearance angle is recommended. If the reamer is to be used for brass or bronze, the corners should be stoned to 1/64 in. radius. A chamfer of 30° and 1/16 in. wide is advisable on line reamers.

A large proportion of radial drill work in the jobbing shop is of a special nature, and can be done economically with the combination boring tool shown in Fig. 2.

These tools are made of high-speed steel flat stock with an allowance of .015 on the thickness and .020 in. on the diameters for grinding. After turning, a 3° clearance is filed on the ends, which come to a sharp edge; and a 5° eccentric clearance is filed on the diametrical dimensions. A land 1/16 in. wide should remain after grinding.

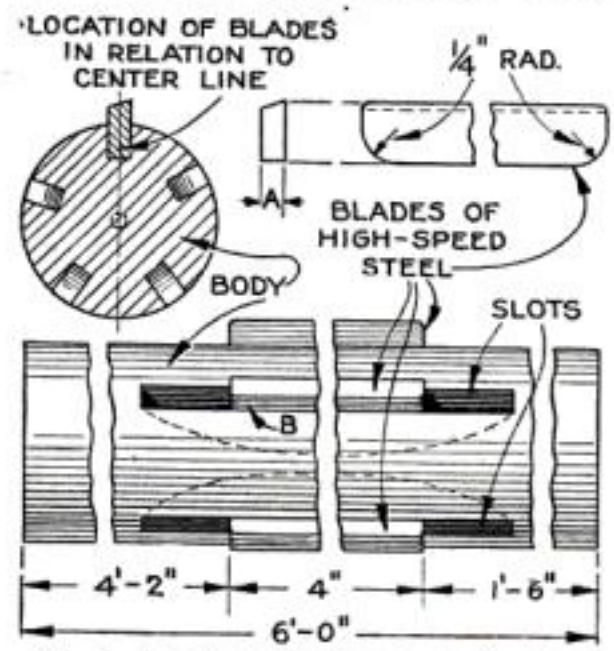

Fig. 4. Details of the line reamer illustrated in Fig. 1. Grind *A* .002 in. oversize, drive the blades in slots milled with a 3-in. slitting saw, and solder the blades slightly at the edges *B*

When the tools have been hardened, they are surface ground. Exactly the same amount is removed from each side to keep the cutting edges concentric. They are then ground cylindrically to the required sizes.

To resharpen the tools, it is necessary only to surface grind .003 or .005 in. off each side, grinding lengthwise beyond the cutting sections only. To avoid wheel cracks, not more than .001-in. stock should be removed at a time if the tool is ground dry.

Suggestions on boring in the turret lathe will be given in a following article.

How to Test Brass and Bronze

By W. H. HAMMOND

Phosphor bronze, when dipped in a solution of ferric chloride, hydrochloric acid, and water, turns dark or black.

SIX types of brasses and bronzes are in general use by mechanics. These are Muntz metal (brass), tube brass, admiralty bronze, bearing bronze, phosphor bronze, and manganese bronze.

These metals do not rust as do steel and iron; nevertheless they vary widely in resistance to corrosion, hardness, and ductility. The only accurate tests to distinguish among them are chemical in nature. Since, however, these tests are simple and require only a few test tubes and no reagents that are not obtainable at any drug store, all machinists and amateur metal workers who take pride in the fine quality of their work should be familiar with them.

Most foundry men define brass as an alloy of copper and zinc, and bronze as one of copper and tin with or without zinc and other metals. Tin increases the cost of the metal but tends to produce ductility without corresponding loss of hardness.

Muntz metal and tube brass contain mere traces of tin. The first is a "sixty-forty" alloy of copper and zinc; in fact, it is ordinary yellow brass. Its brittleness prevents its use where any great strength is required. Tube brass, which is a "seventy-thirty" mixture, is ductile enough to withstand a moderate degree of cold bending.

To test for these two brasses, take about half a gram of drillings or filings (equivalent to a small quarter of a level teaspoonful) and dissolve in one eighth of a test tube of concentrated nitric acid, using the tube for solution. The reaction tends to develop considerable heat, so add the acid to the filings drop by drop, with due care for clothes and fingers. When the solution is complete, add an equal amount of warm water and let stand for five or ten minutes.

A clear green solution, free from white sediment (precipitate), indicates that the metal was a brass, because tin gives a white precipitate under these conditions. However, since manganese bronze and bearing bronze contain only a small percent of tin and so might be mistakenly classified as the much inferior brass by the result of this test alone, the experimenter should also make the special tests for these bronzes described below.

NO PRECIPITATE with nitric acid, on a sample which does not respond to the tests for manganese bronze or bearing bronze, practically proves the specimen to be brass. The distinction between Muntz metal and tube brass can be made by color. Tube brass is redder and more coppery in tint.

For service requiring tougher, stronger, and more ductile metal than brass, the shopman should use a bronze. Admiralty bronze contains about ten percent tin and is excellent for small machine parts such as gears and valves, heavy screws and bolts, and for a better grade tubing than given by tube brass. The test for it is the nitric acid test, precisely as given for brass. Admiralty metal under these conditions gives a voluminous white precipitate. Since other less common bronzes yield a greater precipitate, it is advisable to run the test side by side with a comparative test on an equivalent amount of drillings of bona fide admiralty metal. Phosphor bronze contains about the same amount of tin as admiralty bronze, so the special "dip test" for the former metal, given below, should always be applied before a final decision.

Bearing bronzes, sometimes called "Ajax metal," contain between twenty and thirty percent lead and are ideally suited for heavy-duty bearings and for backing the softer Babbitt bearings. The distinguishing test for a bearing bronze is begun in the same way as the nitric acid test, except that no more acid is used than absolutely necessary. Allow any small amount of tin precipitate to settle; then carefully pour off the clear green liquid into another test tube. Add a little thirty percent sulphuric acid (oil of vitriol) and let stand for a few minutes. A heavy white precipitate will form if the metal was a bearing bronze.

PHOSPHOR bronze is an extremely hard, durable alloy of tin, copper, and phosphorus. It stands moderate corrosion and is springlike and tough.

The distinguishing test for phosphor bronze requires a special test solution: Ferric chloride, 25 grams; distilled water, 100 cc.; hydrochloric acid, 25 cc. A test piece of the metal is cleaned and dipped into this solution for exactly ten seconds. The piece is then removed and rinsed under running water. Phosphor bronze shows a film from dark to black wherever this solution touches it.

The special value of manganese bronze is its property of resisting the corrosive action of sea water, acid water, and any type of saline water.

The test for it is begun in the same way as the nitric acid test for brass, using one eighth of a test tube of acid. As soon as the metal is dissolved, add warm water to about three quarters the capacity of the tube; then add about half a teaspoonful of dry red lead. For this test true red lead, or minium, must be used, and not the yellow pigment, or litharge. As soon as the red lead is added, the solution will turn dark brown and bubbles of gaseous oxygen will appear all through it. Let it stand for ten minutes, or enough longer for the brown to clear up and for the lead to settle completely to the bottom. If the metal was manganese bronze, the clear green solution will have turned to a rich purple.

Old Bill *Says*—

FOR facing off a casting on the milling machine, a fly cutter does better work than an end mill.

High speeds will soon ruin a knurling tool.

A large needle and a ball of modeling clay (purchased at any ten-cent store) are a handy combination for setting work to fine lay-off lines on a machine. The clay can be shaped and pressed wherever needed, and the needle can be stuck in any position desired.

A tight belt eventually means a bad bearing.

If milling cutters are hung on wooden pegs on the wall near a milling machine, considerable time may be saved in selecting one of the desired size and shape.

When cutting a short spiral slot on centers in a milling machine, feed by hand on the dividing head and lift the end mill out of the slot at each cut. This will eliminate errors due to the backlash in the gearing.

TIME DEPENDS UPON ACCURACY

AS we sit in the comfortable seats of today's fast trains we give little thought to the giant up ahead whose power permits us to check off the miles by the minutes on our watch.

Cylinders, pistons, driving rods, bearings, pins—all moving parts of this efficient monster must be accurately fitted to withstand the strain of exacting schedules. Both in the manufacture and subsequent upkeep, skilled mechanics are constantly checking to insure accuracy. It is in this tremendously important mechanical work that Brown & Sharpe Tools — micrometers, gauges, rules, calipers, squares — are universally used in checking sizes and clearances.

In every industry where performance depends upon mechanical accuracy you will find Brown & Sharpe Tools are the choice for important measurements.

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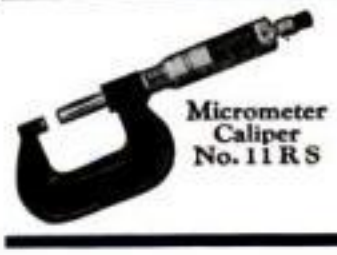
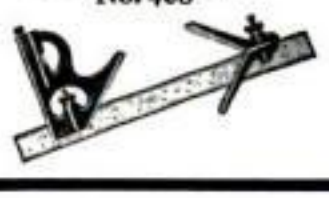

Micrometer Caliper No. 11 R S

Planer and Shaper Gauge No. 625

Outside Spring Caliper No. 811

Combination Square No. 408




Inside Micrometer No. 264

Building a Sturdy Workbench

By

L. M. ROEHL

By placing the tool racks on the sides of the bench, the top is left unobstructed and free of dust-collecting recesses.

IN AN effort to develop an improved woodworking bench for home and farm shops and for country schools and after much experimental work, the Department of Rural Engineering, Cornell University, Ithaca, N. Y., designed and built the bench illustrated, which has many noteworthy features besides its sturdiness and simplicity. Its broad top gives ample room for two workers; and, when used as a single bench, it provides that extra expanse of working space that every mechanic desires for laying out and assembling large jobs. So that the top may be kept flat and free of tool racks and other recesses for sawdust, the tools are placed in racks on both sides of the bench.

As to the materials, everything needed in the construction is listed on page 96 and can be obtained at local hardware and lumber dealers.

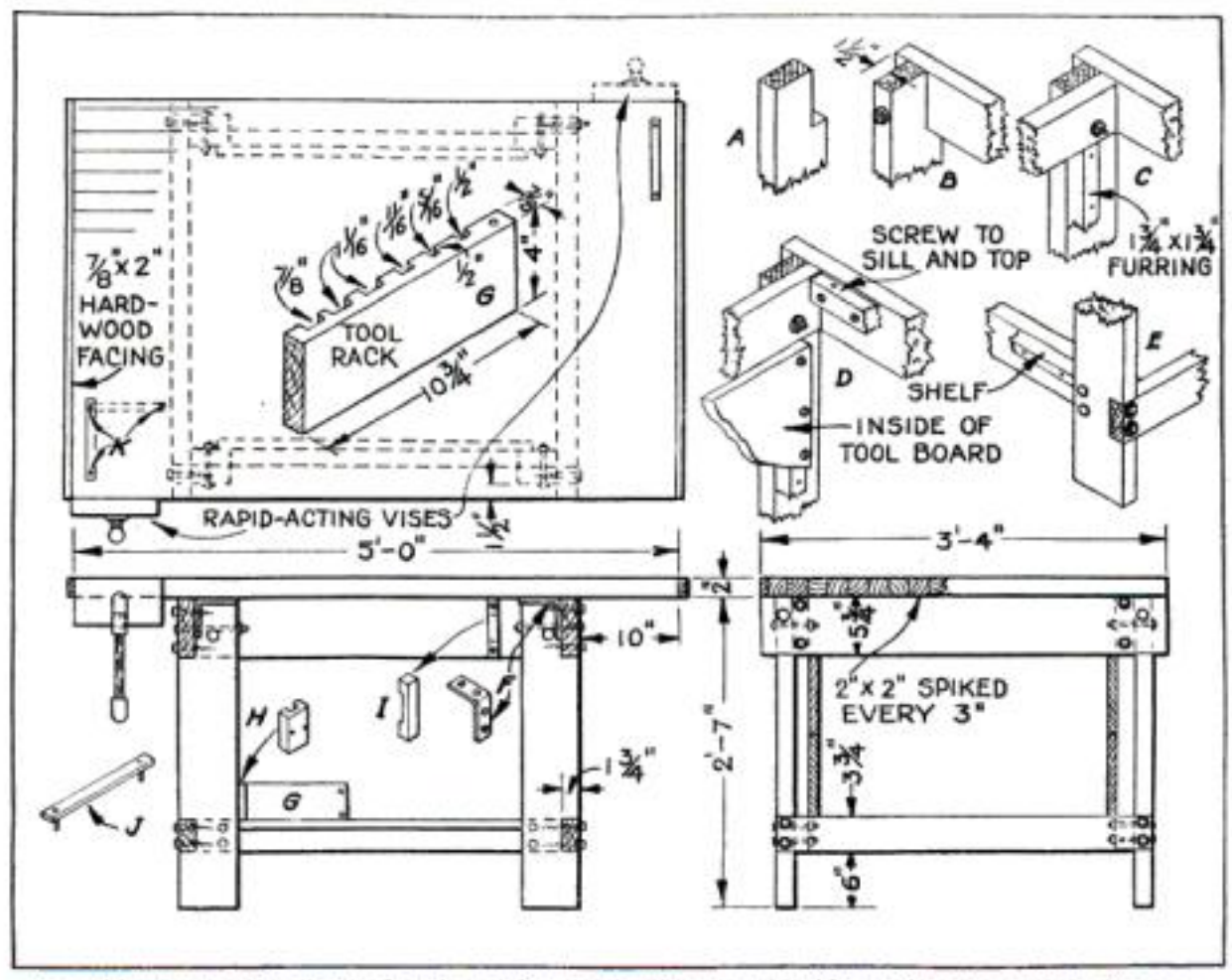
Lay out the dadoes for the lower cross braces at a distance of 6 in. from the bottom end of the legs (see sketch *E*).

The joint at the upper end of the legs for the cross sill should fit flush as shown in detail drawings *A* and *B*. The two lower cross braces are next fastened in place by placing two ½ by 4 in. lag screws at each joint.

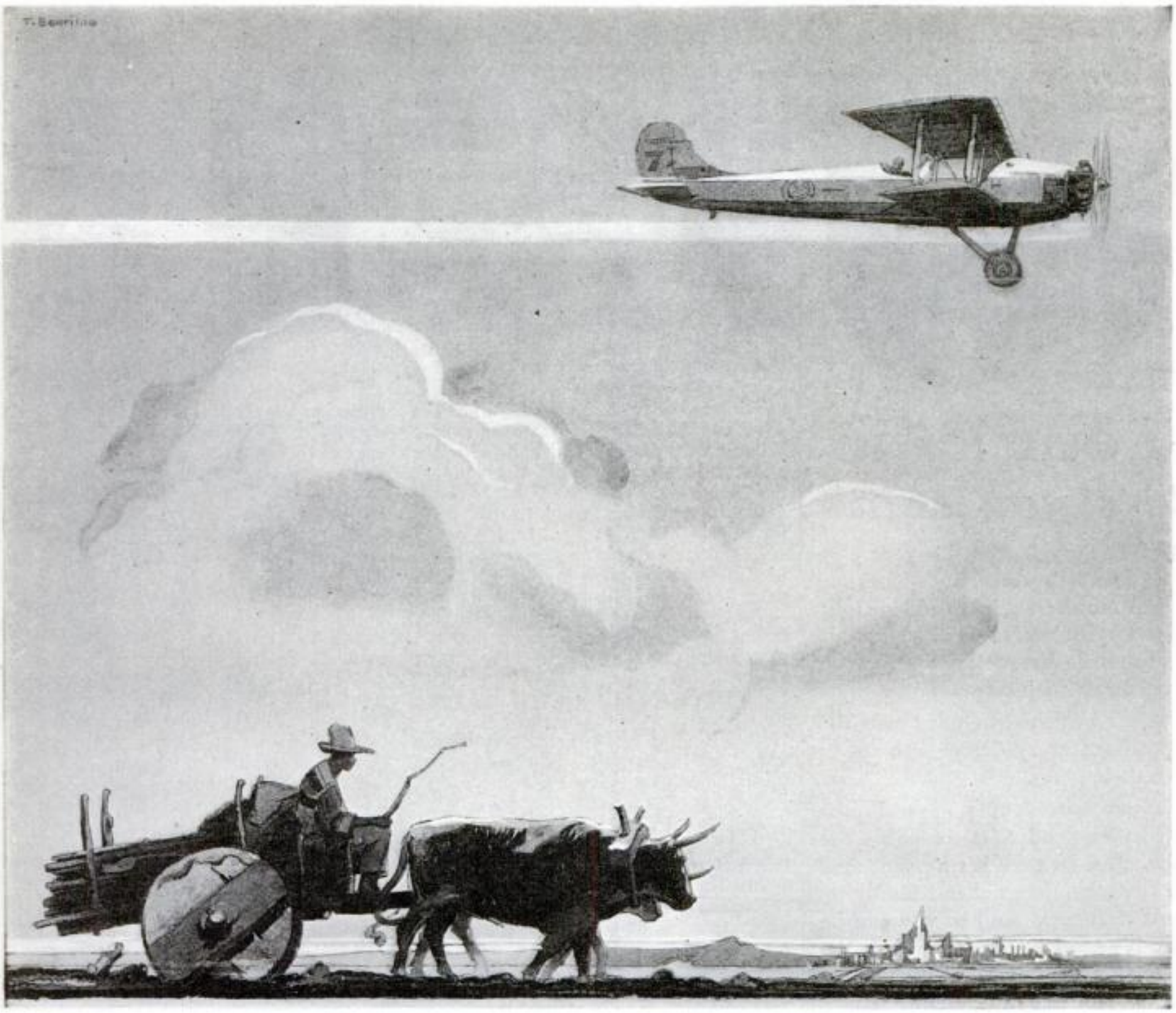
Fasten the cross sills with ⅜ by 6½ in. carriage bolts, washers, and lock nuts, as shown at *B*. Note that the end of the sill projects 1½ in. out from the legs. The other sills are fastened by placing one ⅜ by 4½ in. carriage bolt at each joint as shown in detail sketch *C*. Washers and lock nuts should be used here also. Place the bolt just below the bolt that holds the cross sill in place.

The bottom braces that extend lengthwise of the bench are fastened with two ⅜ by 4½ in. carriage bolts at each joint. Two ½ by 4 in. lag screws driven through the cross sill and into the end of the other sill will serve to strengthen the lower frame.

For the top, 2 by 2 in. pieces of hardwood are preferable. They are spiked together with sixteenpenny common



Assembly views of the double bench and five perspective sketches illustrating the method of assembling the sills and legs. Note the construction of the tool rack, file rack, and metal bench stop.



"To save time is to lengthen life—"

"ACCELERATION, rather than structural change, is the key to an understanding of our recent economic developments."

—FROM THE REPORT OF PRESIDENT HOOVER'S COMMITTEE ON RECENT ECONOMIC CHANGES

THE PLOD of the ox-cart. The jog trot of the horse and buggy. The rush of the high-powered motor car. The zoom of the airplane. Acceleration. *Faster* speed all the time.

Speed and more speed in production, transportation, communication, and as a result, more wealth, more happiness, and yes, more leisure for us all.

Scientific research has been the pacemaker of this faster, yet more leisurely, existence. At a steadily increasing rate it is giving us hundreds of inventions and improvements which speed up work, save time and money, revolutionize life and labor in the modern age.

Conceive how much time modern electric lighting has saved the American people—not to mention the billion dollars a year in lighting bills saved by the repeatedly improved efficiency of the MAZDA lamp. Think of the extraordinary democratization of entertainment and education made possible by the radio tube!

Both these benefits to the public owe much to the steady flow of discovery and invention from General Electric laboratories. So do the x-ray and cathode-ray tubes, the calorizing of steel, atomic-hydrogen welding, the generation of power for home and industry at steadily lower costs.

The G-E monogram is a symbol of research. Every product bearing this monogram represents to-day and will represent to-morrow the highest standard of electrical correctness and dependability.

FOR THE HOME—General Electric and its associated companies manufacture a complete line of electric products including G-E MAZDA and G-E Edison MAZDA lamps, G-E refrigerators, G-E fans, G-E vacuum cleaners, G-E wiring systems, Edison Hotpoint heating appliances, and G-E motors for other household electric products.

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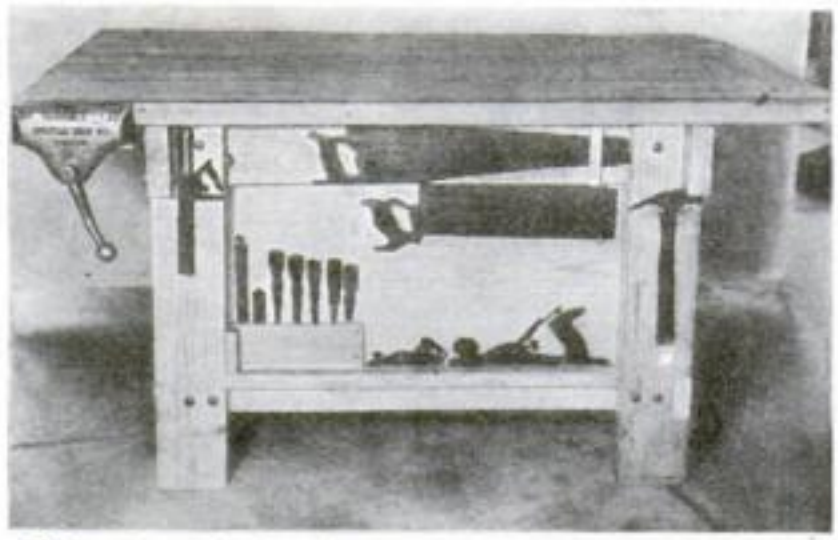
GENERAL ELECTRIC



If the shapes of the tools are painted on the tool racks, it is possible to tell at a glance just where each tool should be placed.

nails placed about 3 in. apart. When the required width has been built up, square a line across at each end and, with the crosscut handsaw, cut off the ends at right angles to the edge. If hardwood is used, it may be necessary to drill holes for the spikes. A ⅞ by 2 in. hardwood strip is fastened to each side and a ⅞-in. hardwood facing piece is placed at each end after the vises have been put in place.

To the inside of the sills at the top, fasten 2 by 2 in. pieces as shown in detail sketch *D*, using six 3-in. No. 14 screws at each sill. Leave a space of ⅛ in. between the 2-in. piece and the top to allow the screws to draw the top down tight.

Place the top on the floor, bottom side up, set the frame on it, and fasten the top to the frame by using six 3-in. No. 14 flathead wood screws at each sill.

To prevent the edges of the top from raising from the sill, an angle iron is fastened at the end of each sill with ⅜ by 1½ in. lag screws as shown at *F*.

Furring pieces 1¾ by 1¾ by 18 in. are fastened as at *C* to the inside of the legs with tenpenny common nails, six being driven in each piece. The tool boards are made up of two pieces and held with screws as in sketch *D*.

Lag screws are used to hold the two rapid-acting vises in place.

A ⅞ by 1¾ in. by 2 ft. 4½ in. board is nailed to the side of the bottom brace, making a shelf on which to place a 14-in. jack plane, a block plane, and a wooden tool rack. Detail drawing *G* shows how to make the tool rack. It holds the following tools in the order written; T-bevel, 2-ft. fourfold rule, 1-, ⅝-, and ¼-in. chisels and 6- and 4-in. screw drivers. Detail *H* shows the construction of the rack for a half-round wood file. This rack is fastened to the edge of the leg as shown in the photograph and assembled front view.

The crosscut handsaw is held by a block such as shown at *I*. The block is ⅞ by ⅞ by 5¼ in. and has a ¼ by 2⅝ in. recess cut in its inside edge. The handle end of the saw is placed on a common nail. The back saw is placed on the tool board, teeth facing up, by hanging the handle end on a nail with the head removed and resting the tip on a screw hook.

Two tenpenny nails, placed on the right leg as shown in the photograph, form a rack for the hammer. Another tenpenny nail on the face of the left leg holds the combination try-square.

When all the tools are in place, draw a line around each and paint in the shapes with black paint (see illustration above).

In making the bench stop, drill two 5/16-in. holes 1 in. from each end of a ¼ by 1 by 8 in. piece of iron and thread them with a ⅜-in. tap. Fit two bolts into these holes and turn the bolts in tight to the end of their threads. Cut off the ends that project through; then cut each bolt 1 in. from the flat piece as shown in sketch *J*. These pegs fit into the 5/16-in. holes *K* in the top of the bench.

What Is Needed to Build a Double Workbench

Cutting List

No. of Pcs.	T. in.	W. in.	L. ft.	L. in.	Part
4	1¾	5¾	2	7	Legs
2	1¾	5¾	3	4	Cross sills
2	1¾	5¾	3	½	Sills
2	1¾	3¾	3	1	End braces
2	1¾	3¾	3	½	Braces
22	1¾	1¾	5		Top
2	⅞	2	5		Top facing
2	⅞	2	3	4	Top facing
2	1¾	1¾	3		To fasten top
2	1¾	1¾	2	6	To fasten top
4	1¾	1¾		18	Furring for tool board
4	⅞	8	2	8	Tool board
2	⅞	⅞		5¼	Saw rack
2	⅞	4		10¾	Tool rack
2	1¾	10		10	Furring between vise and top
2	⅞	2⅝		4	Rack for half-round file
2	⅞	1¾	2	4½	Shelf

Other Materials

- 4 carriage bolts (cross sills to legs) ⅜ by 6½ in.
- 12 carriage bolts (braces to legs) ⅜ by 4½ in.
- 4 machine bolts ⅜ by 2 in. for bench stops.
- 16 ⅜-in. lock washers.
- 16 ½ by 4 in. lag screws to assemble frame.
- 16 ⅜ by 1¼ lag screws for angle irons.
- 4 doz. 1¾-in. No. 10 flathead wood screws to fasten facing to tool board.
- 24 3-in. No. 14 flathead wood screws to fasten top to frame.
- 24 1¾-in. No. 10 flathead screws to fasten tool board.
- 6 1½-in. No. 9 roundhead wood screws to fasten tool rack.
- 24 tenpenny nails to fasten furring to legs.
- 12 tenpenny finishing nails for shelf.
- 8 lb. sixteenpenny common nails for top.
- 16 eightpenny nails to fasten furring.
- 8 corrugated fasteners for tool board.
- 4 4-in. angle irons to fasten top to sills.
- 2 pieces ¼ by 1 by 8 in. iron for bench stops.
- 2 rapid-acting vises.

With correct, compact blows on steel heated to exact temperature, giant power hammers forge Vlchek tools without hair-lines, flaws, or weakness.

The Dawn of Better Tools at Lower Prices

No reason for worn-out tools to hinder your work. At little cost, you can fill your tool kit with fine, high grade Vlchek tools that are scientifically made and shaped to increase your mechanical skill. Slovenly workmanship, mutilated bolts and nuts are becoming a thing of the past.

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Select a set of these modern tools at your hardware or automotive accessory store—compare their usability, toughness, and value, with any other kind. You will appreciate the Vlchek success in giving you fine hand tools at a lower price.

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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Two Occasional Tables

By HERMAN HJORTH

COFFEE tables and smoking stands fill a genuine need in every modern home. The two designs illustrated on this and a following page are not only attractive and sturdy, but should prove instructive projects for the craftsman in wood. The material for either of the pieces can be purchased for approximately three dollars—a figure far below the commercial value of such tables.

The coffee table shown in Fig. 1 is a copy of an English Renaissance design. This period of furniture dates back to the seventeenth century and is a modified form of the Italian Renaissance, which originated in Italy about 1500. To be true to the period, the table should be made of either white oak or walnut. Other cabinet woods, however, may be used if desired.

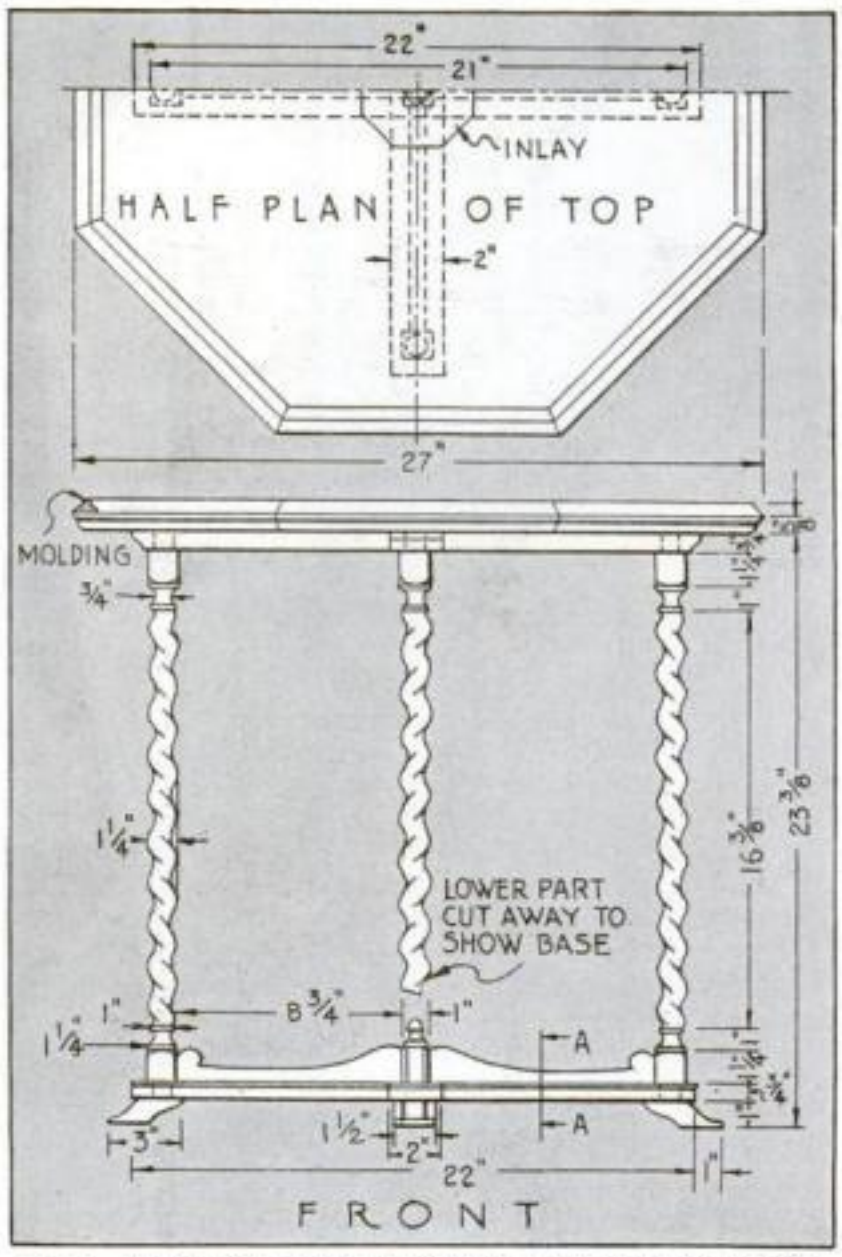

Fig. 1. Assembly views of the English Renaissance design coffee table. An octagonal inlay serves to decorate the eight-sided top.

First, two crosses should be made, one for the base and one to be screwed to the underside of the top. These crosses are of ¾ by 2 in. stock and are both 22 in. long. In making a cross-lap joint, find the center of both pieces and lay off one half of the width of the pieces on each side of the center lines. Square lines all around and place one piece on top of the other. Face-mark the upper side of both pieces and gage the depth of the cut from the marked side of both. Cut away the waste wood as indicated at the top of Fig. 2.

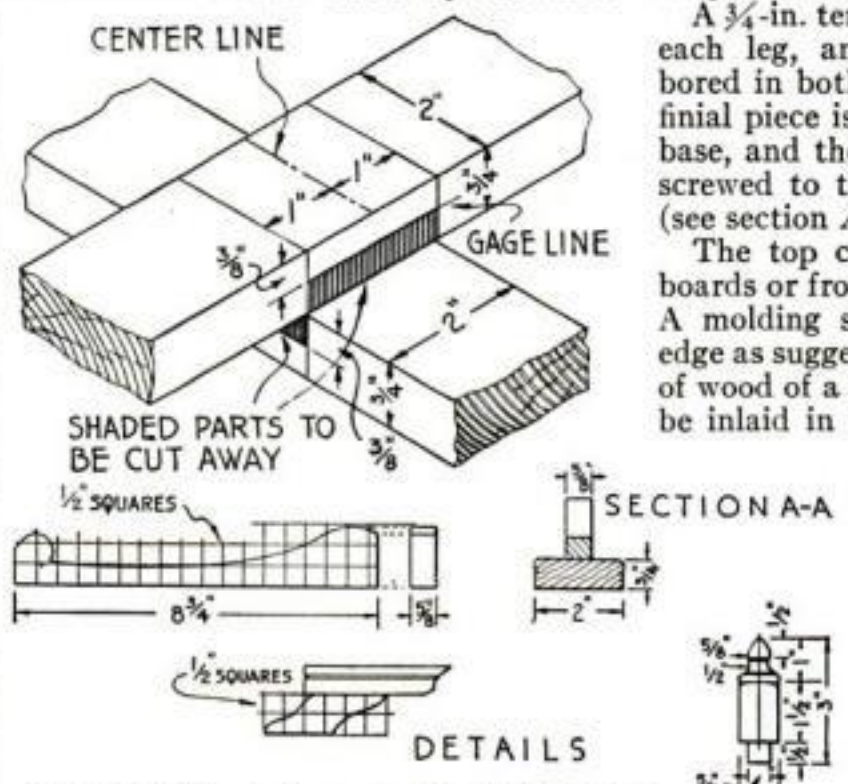

Fig. 2. Method of laying out a cross-lap joint; shape of rails, feet, and ornament; and rail section *AA*.

While a moderate amount of time and patience is required in doing the spiral turning on the legs, anyone with an average amount of woodworking ability should encounter no serious difficulties. For details of this type of turning see P.S.M., July '29, p. 90, or the *Home Workshop Manual*, p. 181. If desired, a simpler form of turning may be used.

A ¾-in. tenon is turned on both ends of each leg, and corresponding holes are bored in both crosses. The ornament or finial piece is placed in the center of the base, and the four 8¾-in. leg braces are screwed to the base from the underside (see section *AA* in Fig. 2).

The top can be made from glued-up boards or from a single piece of plywood. A molding should be fitted around its edge as suggested; and an octagonal piece of wood of a different color and grain can be inlaid in the center of the top. The edge of the top and base may be decorated by rounding it with sandpaper and scratching a line with a marking gage.

If made of white oak, the table should be stained and then rubbed lightly with No. 00 steel wool in order to give certain parts, as for example the convex parts of the spiral turning and the

edges of the top, the appearance of wear. It should then be given a coat of paste wood filler, thinned with turpentine to the consistency of cream, which can be applied with a brush. When the surface loses its luster, rub it across the grain with a piece of cotton waste to force the filler into the pores of the wood. Wipe the surface clean and allow it to dry for at least 24 hours. The table next should be given a coat of shellac, which is rubbed down with steel wool when it dries. Then it can be polished with paste or liquid furniture wax.

The modernistic smoking table illustrated in Fig. 3 consists of ten simply constructed pieces—four legs, four feet, a shelf, and a top.

On each end of each leg a 1 in. diameter tenon ½ in. long is turned. Inside this a 1¾ in. diameter shoulder is formed, the top shoulder being ¾ in. and the bottom one 1¼ in. in length. For details regarding the process of reeding see P.S.M., July '29, p. 90, or the *Home Workshop Manual*, p. 179.

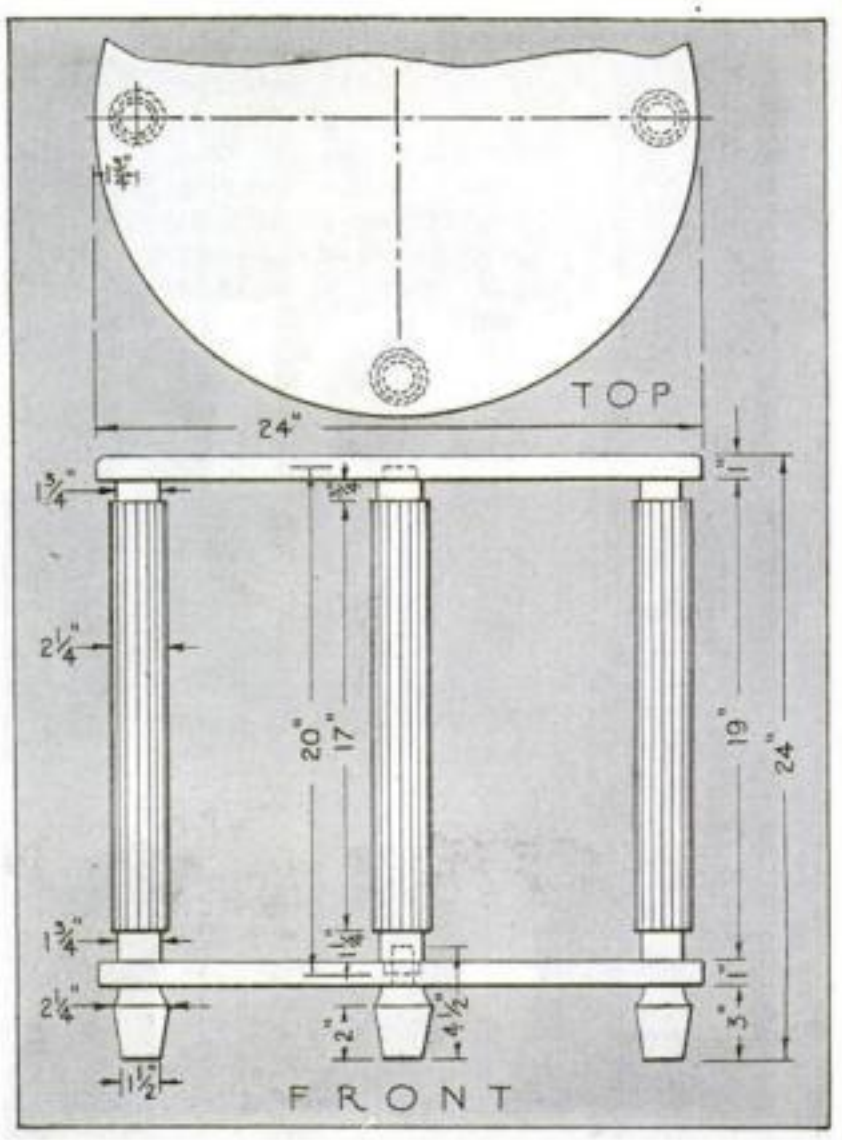

Fig. 3. Any attractive, close-grained wood can be used in the construction of this modernistic smoking stand or coffee table.

The top and shelf are made of boards at least 1⅛ in. thick and planed down to a uniform thickness of 1 in. It is best to plane across the grain of the wood until the surface is flat. Test repeatedly with a steel square, placing the square not only straight across the board, but also diagonally from corner to corner. Finish by planing and scraping along the grain. Gage the thickness on the sides and ends of the boards and plane the other surface to the desired thickness.

The top and shelf pieces may also be made by gluing several layers of plywood together. This is easier because no planing is necessary, only scraping and sanding. The layers should be clamped to a flat surface while the glue is drying.

The circular outline of the boards is marked as follows: Drive two brads, 12 in. apart, through a small stick of wood. Place one of the small points in the center of the board and mark the circle with the other by revolving the stick. Saw out and finish the edge by sanding it on a disk mounted on a faceplate (see P.S.M., July '29, p. 124). A disk sander of this type is useful and very easy to make. Turn a disk of soft wood such as white pine or cypress about 2 in. thick and of as large diameter as the lathe will swing. Face it off so that it is perfectly level and smooth, and glue a piece of No. 1½ sandpaper to it. When dry, trim off the edges of the sandpaper and screw the faceplate on the live spindle.

Lay out the centers for the tenon holes in top and shelf, and bore them halfway through the wood. Bore small holes (about ⅛-in.) in the center of the 1-in. holes through the shelf, but do not bore through the top. These serve as centers for the ⅝-in. holes to be bored for the turned feet.

Glue the four legs, the top, and the shelf together, being sure to place the top and the shelf so that all of the grain runs in the same direction. Turn the four feet according to the drawing, bore the ⅝-in. holes, and glue the feet in place.

If the stand is made of maple, birch, or a similar light-colored wood, a striking effect may be produced by painting the edges of the top and shelf, as well as the shoulders above and below the reeding, with black lacquer. This is especially desirable if the top and shelf are made from several layers of plywood.

The surface as well as the reeding should be given a coat of white shellac thinned with alcohol. This should then be rubbed down with No. 00 steel wool, after which one or two coats of clear lacquer should be applied. The lacquer may be rubbed down with No. 5/0 waterproof sandpaper.

Bill of Materials

No. of Pcs.	Part	T. in.	W. in.	L. in.
	FOR COFFEE TABLE			
4	Legs	1¼	1¼	22⅜
4	Crosses	¾	2	22
4	Feet	1	1½	3
4	Base	⅝	3	8¾
1	Finial	1	1	3
1	Top	⅝	27	27
1	Molding	½	1	96
	FOR SMOKING STAND			
4	Legs	2¼	2¼	20
4	Feet	2¼	2¼	4½
2	Top and shelf	1	24	24

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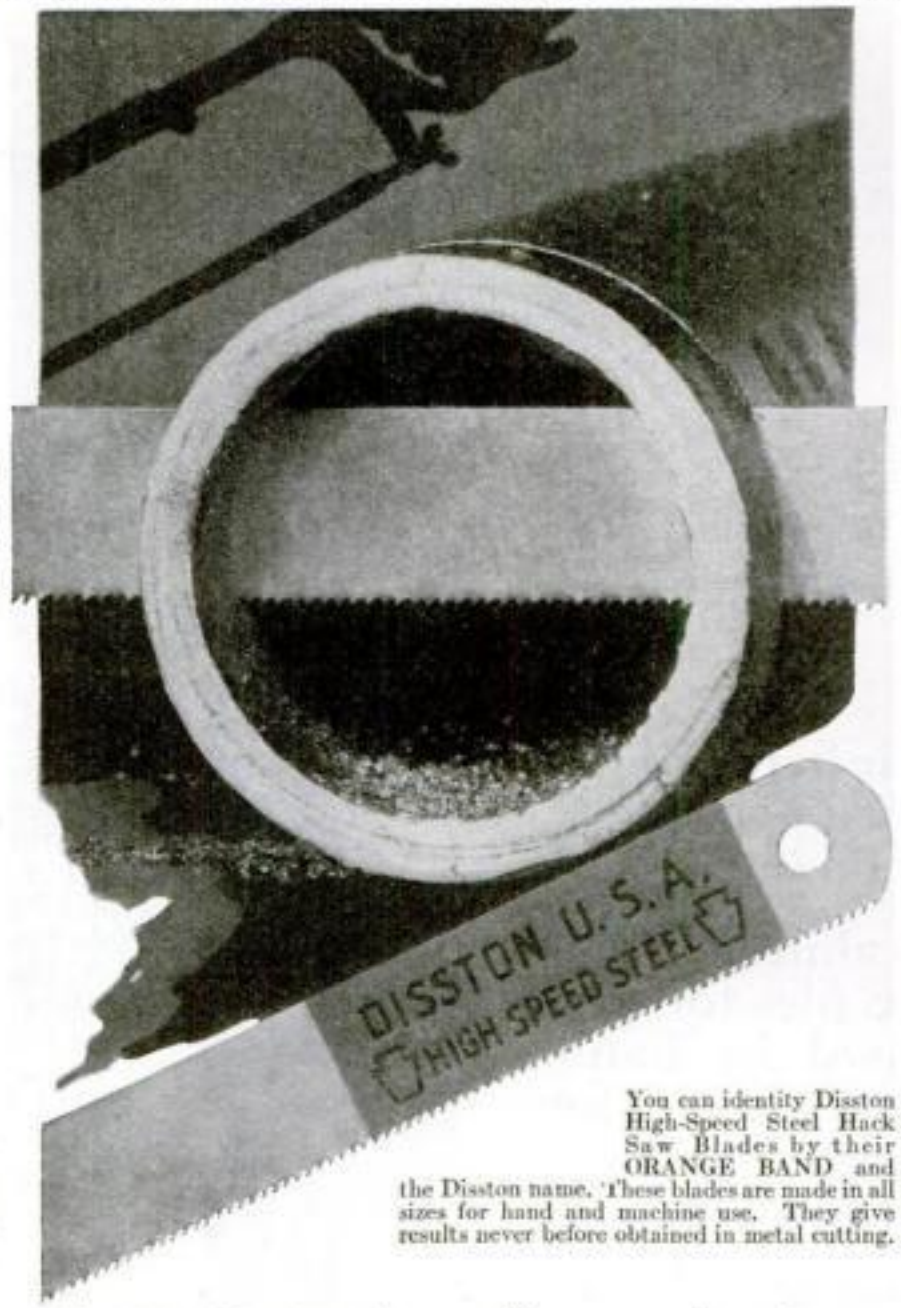

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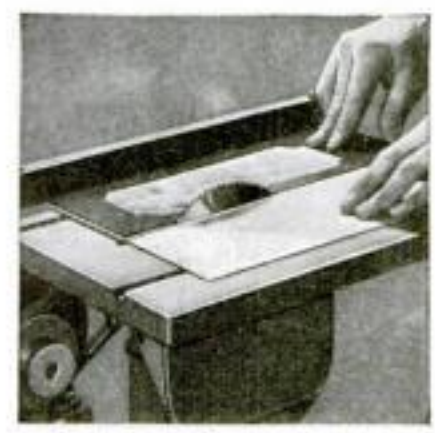

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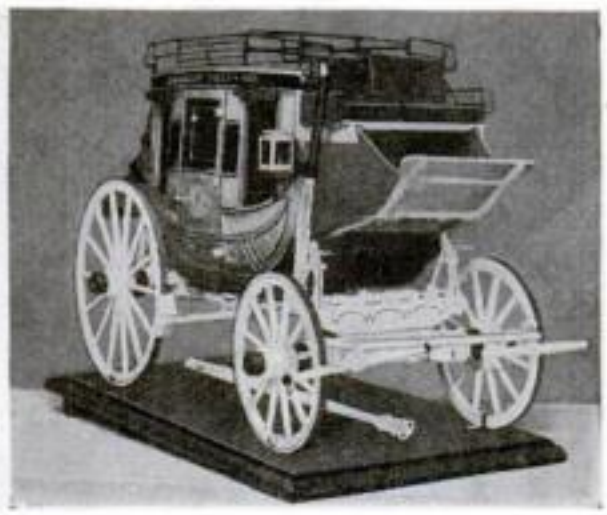
This seal on an advrtisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Stagecoach Model Making Sweeps the Country

IN THE few months since POPULAR SCIENCE MONTHLY introduced the new hobby of stagecoach model making with a series of articles on the construction of the now famous *Diamond Tally-Ho*, the vogue for decorative models of this type has swept from coast to coast.

Among the first to realize the popularity of coach models were the department stores. One of the largest and most exclusive stores in New York hastily gathered a collection and put it on exhibition. Not only the general public, but interior decorators, magazine and newspaper feature writers, and buyers from other stores visited the exhibition. So great was the demand for replicas of the models, that arrangements had to be made for their manufacture on a production basis.



Model of the *Diamond Tally-Ho* built by Edwin M. Love. It is 10 by 13 by 20 in. over all.

Writing of this exhibition in the *New York Times*, Walter Rendell Storey, a specialist on interior decoration, made this comment:

"Ship models, which have long been useful accents in certain types of interiors, now have a rival in the models of stagecoaches. This decorative touch seems a logical development, for models of stagecoaches are obviously a complement to the frigates and old-time clippers of the ship model maker. Perhaps soon we will have stagecoach model clubs where amateur model makers, like the makers of miniature ships, will compete with one another in bringing back to us famous and picturesque models of early vehicles of transportation. Suggestions of old coaching days, long a subject for prints and other forms of pictures, may now be recalled through miniature models on the hearth mantel or may adorn the top of a desk."

What Mr. Storey says is borne out by the enthusiasm with which readers greeted the stagecoach articles in our February, March, and April issues and by the demand for POPULAR SCIENCE MONTHLY Blueprints Nos. 115, 116, and 117, which give full size drawings of the stagecoach illustrated (see page 111).

Next in the POPULAR SCIENCE MONTHLY stagecoach series is to be a scale model

of a covered wagon now in the Pony Express Museum at Pasadena, Calif. The first installment will appear in the June issue.

There never was a more appropriate time to build a prairie schooner model, for this year is the centennial of the covered wagon. The first wagon train left St. Louis, Mo., for the long and hazardous trip to the Oregon country on April 10, 1830.

This was an event of such historic importance that President Hoover recently

The covered wagon model to be described in the following issue of POPULAR SCIENCE MONTHLY.

issued a formal proclamation asking the Nation to observe the period from April 10 to the end of the year as the "Covered Wagon Centennial," and in so doing to "recall the national significance of this centenary of the great westward tide which established American civilization across a continent."

Because of the many novels and motion pictures which have portrayed vividly the pioneer life of the West, the covered wagon has become a symbol of that great period in American history. What could be more appropriate than to build a model of one of these picturesque old vehicles to serve alike as an ornament and as a reminder of the heroic days of the Santa Fé and Oregon trails?

Hints on Making Screens

TO LAY out window screens, the safest way is to make a measuring rod from a light strip of wood. Cut it the exact length of the screen and mark on it the exact width; or, better still, cut a second piece to represent the width.

The stock should be approximately 1⅛ or ⅞ in. thick by 1½ or 2 in. wide for the stiles and cross rails; and 1⅛ or ⅞ by 2½ or 3 in. for the bottom rails of all except the smallest screens. These dimensions are not hard and fast; your lumber dealer will have in stock suitable material for making screens and will know what is customarily used by the carpenters in your own neighborhood.

Figure the number of lineal feet necessary and get the same number of feet of screen molding, which is used to cover the raw edges of the screen cloth. Your lumber dealer may have a special screen molding for this one purpose, or he may give you ½-, ⅝-, or ¾-in. half-round molding, which is often used and will be quite satisfactory.

Naturally, after going to the pains of making good screen frames, a home worker would be shortsighted to cover them with anything but high-grade wire insect screening.

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Skillful staining or painting will bring an old mantel into harmony with any modern color scheme.

New Finishes for Brickwork

Stains and Dyes—Glazed, Shaded, and Plastic Effects—Cold Water Paints

By BERTON ELLIOT

FIREPLACES, mantels, chimneys, and interior brick surfaces may be modernized in various ways to harmonize with new decorative schemes. The old notion that brickwork must remain always the same in appearance has been dispelled. Indeed, bricks can be finished in practically any shade or tint desired without destroying the characteristic texture that gives them their charm.

One of the simplest methods is to treat brickwork with ordinary shingle stain. This soaks in without producing a glossy film over the surface. Where the brick is neatly pointed with white, black, or colored mortar, the stain may be applied carefully with a small brush to one brick at a time so that it will not run over the mortar joints.

The standard shingle stain colors should be reduced with kerosene or naphtha to the desired tint, care being taken not to have the mixture too strong to start with. It is easy to increase the intensity of the tone, but if too deep a stain is once applied to the surface, it cannot be lightened. If a few bricks can be obtained similar to those you desire to finish, try the stain on them, experimenting until you obtain the right effect.

In applying the stain, no attempt need be made to bring the different bricks to a uniform color tone. Apply an even coating over the entire surface so that the individual bricks will retain their individual depth of hue. This gives a rather pleasing mottled effect characteristic of brickwork.

Another method is to color the bricks with water soluble aniline stains, which come in powder form and are sold by the larger paint supply stores. They are dissolved in hot water in proportions to give the strength of color desired. Such colors as brown mahogany, walnut, red mahogany, and Bismarck brown are suitable for the coloring of brick, according to the effect desired. The brickwork should be washed with water immediately before applying the stain. Aniline stains, like shingle stains, will color the bricks without filling up the depressions or changing the natural texture of the surface.

If the bricks are too dark in color to be changed to a desired lighter effect, they may be painted with a suitable foundation or background color, over which a semitransparent glaze coat is applied, and wiped off as desired.

The background color is generally flat wall paint or other flat drying paint. Ivory, buff, and light shades of green, blue, and gray are the colors most extensively used. Two or three coats should be applied, depending upon how porous the bricks are. The first coat should be thinned with a generous amount of linseed oil and a little turpentine to satisfy the absorption demand of the brick.

When the foundation has become thoroughly dry, the glazing may be done with oil colors and glazing liquid in the same way as the familiar "Tiffany" blending on walls. Oil wood stains are often used for glazing instead of oil colors.

When the glazing method is used, the foundation color is generally applied over the entire surface without any attempt to keep it from getting on the mortar joints. It may, therefore, be sprayed if a hand or electric sprayer is available. Indeed,

those who understand the use of a spray gun can spray on the glaze stain coat in shaded or stippled effects, similar to those used in the decoration of painted furniture.

IN DECORATING fireplaces, plastic paint sometimes can be used to advantage, especially over surfaces in poor condition. It can be applied to wood and tile fireplaces, as well as brick. With its aid old-fashioned fireplaces or mantels may be transformed; and if it happens that there is too large an area of exposed brick in a room, it may be blotted out. The plastic paint is brushed on in an unbroken coating and is then usually stippled to produce a pebbled or rough textured effect, or modeled into relief designs. The manufacturers supply full directions. When the finish has hardened, it may be given a glaze, polychrome, two-tone, or any other color treatment desired.

Basement walls form another class of interior brick surfaces. They do not require the more delicate treatments just described, except in the case of lounging or billiard rooms. With basement walls the requirements are economy, neatness of appearance, and serviceability under more or less hard wear.

Brickwork in a basement (or, for that matter, anywhere else) should never be painted immediately after the brick is laid. It always has a certain lime content, which will tend to burn the paint as long as the lime remains active. On inside surfaces, however, the lime usually "cools off" within two months, when the bricks ordinarily can be painted without danger.

Another point, quite as important, is that the walls must be thoroughly dry. Moisture, if present, will prevent satisfactory painting. Be sure the brick is dry all the way through; not merely surface dry—especially soft brick.

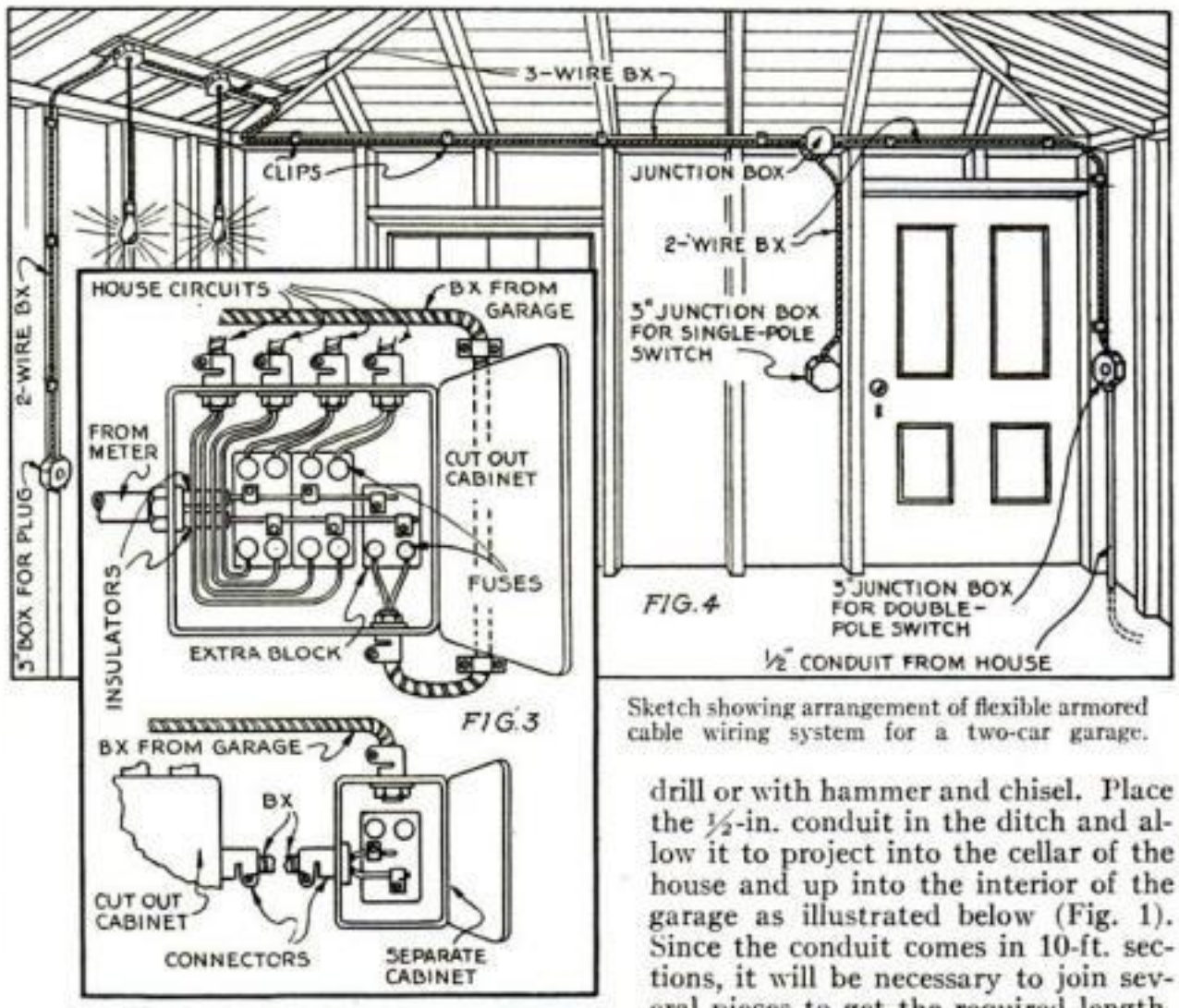
REMEMBER, too, that plenty of oil should be used in the priming coat, as bricks drink in the oil greedily. The softer the brick, the more oil should be used. Not less than three coats should be applied for assurance of a good job. The priming coat, when thinned liberally with oil, has very little hiding power, and two more full coats are needed to produce a good finish.

In giving brickwork a plain painted finish, it should be remembered that regular house paint—in fact most oil paints—produce a gloss finish, but special concrete wall paints are available which dry with a flat or dull finish, where this is preferred. Gloss paints, however, are durable and withstand water that is splashed about in mopping floors and using the laundry tubs.

Another material especially adapted for use on basement walls—not only brick but cement, concrete, stone, and wood—is cold water paint, a dry powder, similar in appearance to kalsomine, but made with a casein binder instead of ordinary glue. The casein is insoluble in water and does not run. After being wet, the paint dries out to a smooth, even surface. Because it can withstand water, cold water paint is a practical and economical material for use on basement walls and partitions.

Wiring a Small Garage

By HAROLD P. STRAND



The two methods which can be used in installing the additional cut-out or fuse block.

Sketch showing arrangement of flexible armored cable wiring system for a two-car garage.

WIRING a garage should not be a difficult problem for any mechanically minded man if he will observe the few general hints which follow and will take the time to learn the wiring requirements of the building code in the locality in which he lives.

In some places there are special rules governing the application of wire to an outside building; therefore it pays to consult the local authorities before the work is started. If no special rules exist, the work can be carried out in the way to be described. Upon the completion of the work, however, be sure to have the local electrical inspector look it over to see that it conforms to the wiring codes and specifications.

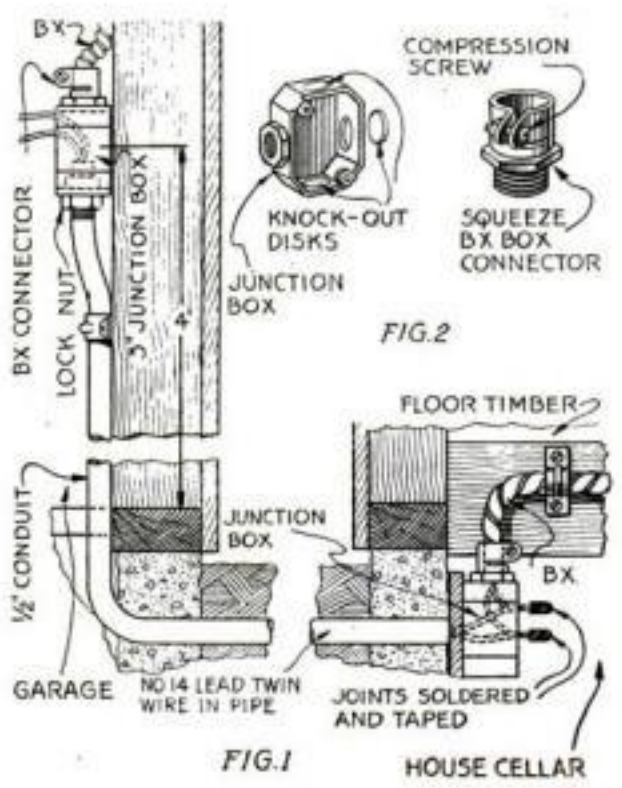
Simplest of all wiring methods is that employing flexible BX cable. The only tools needed are a hammer, screw driver, pliers, sharp knife, hack saw, and soldering copper or blowtorch. BX is easy to work and can be applied to buildings constructed wholly of wood or to those made of cement block, brick, or stone if they have a wooden roof.

The ditch for the feed line—about 1 ft. wide and 1 ft. deep—should run as directly as possible from the house to the garage. This line may be strung overhead, but it detracts from the appearance of the house and may be damaged by storms.

At each end of the trench knock a 2-in. hole through the foundations with a stone drill or with hammer and chisel. Place the ½-in. conduit in the ditch and allow it to project into the cellar of the house and up into the interior of the garage as illustrated below (Fig. 1). Since the conduit comes in 10-ft. sections, it will be necessary to join several pieces to get the required length.

Fasten a 3-in. octagon junction box at the garage end of the conduit as indicated in Fig. 1. Secure the box to the woodwork; or, if none exists, to a 4-in. wide board set upright between floor and roof timbers.

At the house end of the pipe another 3-in. junction box is fitted, this time the entry being made from the back of the box. Measure the length of the conduit and cut No. 14 twin-wire lead-covered cable about 1 ft. longer. With the aid of



The feed line, the 3-in. junction box at the garage end, and a BX box squeeze connector.

a stiff steel fish wire, pass the cable through the pipe.

The feed is continued from the box on the wall of the basement to the fuse box with No. 14–2 cable. A squeeze connector should be used where the cable leaves the junction box. Join the wires at the junction box color to color (see Figs. 1, 2, and 3).

Test the various circuits in the fuse box for a lightly loaded line. If none exists, a separate cut-out block will have to be installed; and if the fuse box is already crowded, it will be necessary to install

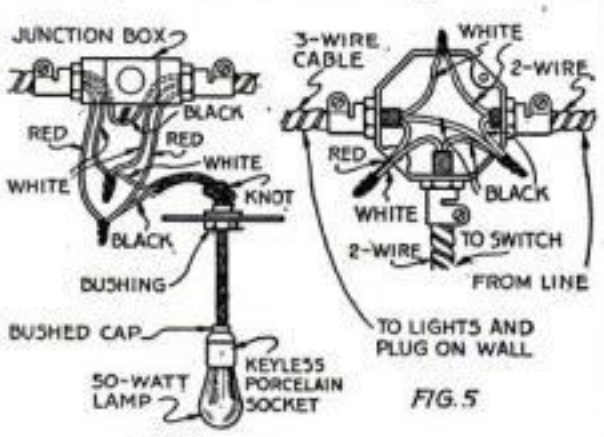


FIG. 6

FIG. 5

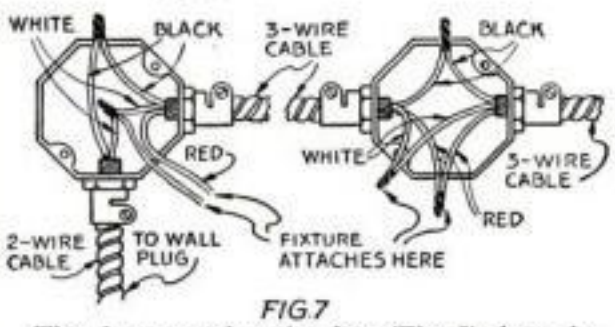


FIG. 7

The three-way junction box (Fig. 5); how the fixtures are installed (Fig. 6); and wiring plans for the two droplight junction boxes (Fig. 7).

another fuse cabinet (see Fig. 3). The white BX wire should be attached to the grounded side of the fuse block.

The wiring in the garage is carried through entirely in BX. At the junction box at the end of the conduit lead from the house, a double-pole switch is placed. This will serve to cut out the entire circuit if it is necessary to do so in order to repair the system.

The No. 14–2 BX cable is carried up and across the wall to a three-way junction box above the switch for the lights (see Fig. 4). A diagram of the wiring for this junction box is shown in Fig. 5. The two-wire cable at the lower edge of the box goes down to the single-pole switch.

Three-wire cable is used from the three-way junction box above the switch to the first light box (see Fig. 6). Wire the fixture in the manner shown, connecting the wires color to color. A three-wire cable runs from this box to the second light box, and the connections there are made as in Fig. 7.

The two wires in the receptacle line are connected color to color to the black and white wires in the three-wire cable that comes from the first light fixture box. Study Figs. 5, 6, and 7 carefully before doing this part of the work.

A word as to the attachment of the ground for this system. If the wiring in the house is BX or metal conduit and if metal boxes are used, the system will be grounded through the metal. If, however, open wiring is used in the house, it will be necessary to supply the new circuit with a suitable ground by putting a

ground clamp on the BX cable and running a piece of No. 10 rubber covered wire from this to a similar clamp placed on a water pipe.

Extracts from important sections of the *National Electrical Code* which concern the wiring operations required for this installation are as follows:

Sec. 3302. Cut-outs, switches, attachment plug receptacles, and lamp holding devices shall be located at least 4 ft. from the floor.

Sec. 3303. Approved portable cord suitable for hard use shall be used to connect all portable lamps, motors, and appliances. One end of the portable cord shall be equipped with a male end pin plug and the other end shall have a handle, socket hook, and guard fastened to the handle.

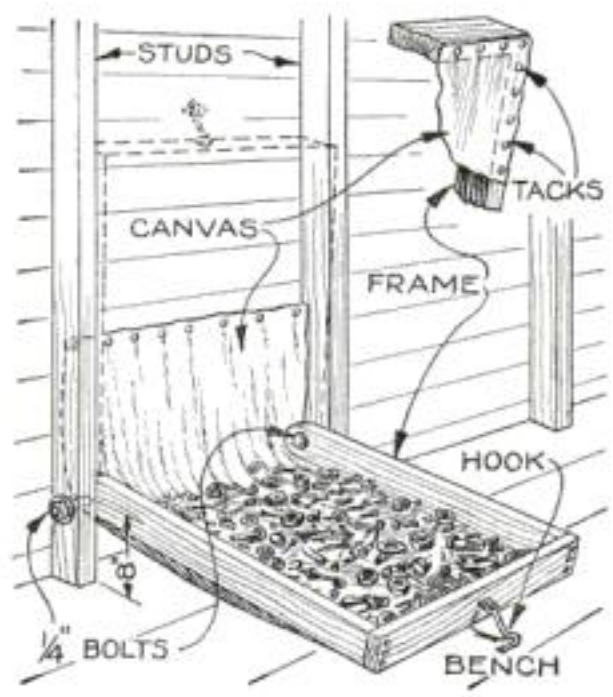
Sec. 503. Conduit shall be installed as a complete system without wires and shall be connected to all boxes and fittings both electrically and mechanically. The ends of the conduit shall be reamed to remove all rough edges and there shall be no splices or joints within the conduit proper. All joints shall be made mechanically and electrically tight without solder, and then they shall be soldered, compounded, and taped equal to the original insulation on the wire.

If first-class materials are used and the work is carefully done, the wiring is reasonably certain to pass inspection.

Shop Storage Tray Simplifies Selection of Odd Parts

IN ALMOST every home shop there are cans and boxes filled with bolts, nuts, and odd parts. Looking for just what you want is a tiresome task, but it can be made easier by the method shown below.

A framework of ¾ by 2 in. strips is built to fit between the studding back of the bench. This is hinged with ¼-in. bolts about 8 in. above the bench top. Canvas is tacked to the lower side of the



When lowered, this convenient hardware holder allows the contents to be sorted.

frame so that it sags sufficiently to make a good pocket. One end of the canvas is left long enough to reach the wall at a point halfway between the pivot bolts and the hook which holds up the container.

When this holder is open, all the parts are spread out. As soon as you have picked up what you need, the frame can be raised and hooked, with all the parts entirely out of sight and off the bench top.—K. RENNER.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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HOME WORKSHOP CHEMISTRY

THE varnishing of small metal articles such as toys is best accomplished by the dip process, especially if many pieces are to be handled. Shellac varnish is excellent, and so is the pyroxylin or celluloid lacquer. Both of these finishes may be colored with dyes, if desired. They give a hard, shiny, durable coating, and the lacquer in particular is not affected to any great extent by moisture.

A dressing for leather belting which prevents slipping is always useful in the modern motorized home shop. Melt together 5 oz. of spruce gum with 1 oz. of ozocerite or what is sold also under the name of cerasine (this is a harder paraffin resembling beeswax) and 3 oz. of rosin. When melted, remove from the fire and add 2 oz. of turpentine. Allow the mixture to become cold and add 10 oz. of alcohol.

Brushing a homemade dressing on a leather belt to prevent it from slipping on the pulley.

Shake the dressing before applying it with a brush on the inner side of the belt.

In order to increase the hardness and strength of paper ornaments, boxes, and novelties, they may be painted with boiled linseed oil. This treatment should be repeated until the oil will no longer penetrate. The drying may be hastened by placing the paper articles in a moderately warm oven, but care should be taken not to heat them to too high a temperature.

Similar results are obtained if the paper or cardboard is painted with specially prepared carpenter's glue. The glue is made ready by dissolving it in water, draining off the excess water, and dissolving the swollen mass with heat. Then acetic acid is added in such a quantity that the glue will remain fluid. Repeated applications of this glue will harden thin cardboard, especially if it is porous, to the solidity of wood. Treated in this manner, the cardboard may be made waterproof by painting or varnishing it with a good grade of spar varnish.

Models of boats, stagecoaches, buildings, and the like may be easily made from this cardboard. Parts that require to be bent can be softened by brushing them again with the glue. The various pieces may be held in place by rubber bands while the glue is drying. When the model is finished, it should be brushed repeatedly with the glue.—H. BADE.

Easy Way to Make Wheels for Model Stagecoach

THERE may be those who, like myself, have had trouble in sawing the felloes of the *Diamond Tally-Ho* stagecoach model. I eliminated the sawing entirely by turning them on the lathe.

A backing of pine ¾ in. thick and 8½ in. square was screwed to the faceplate. The corners were then cut off and the piece was rounded. To this piece was screwed an 8-in. square of plywood ¼ in. thick, the screws being kept near the center. Both the rear and front felloes were then turned from this plywood. Either a parting tool or a skew chisel may be used, but the latter is the quicker.

Felloes are made quickly and simply by this method, and the flat turned edges allow the assembling and finishing operations to be performed without difficulty.

Another suggestion for stagecoach model makers has to do with drilling holes in lead or soft solder with a twist drill. It is a good idea to put a soft piece of candle wax in the hole just as soon as the drill has been centered. This insures a smooth hole of the exact size of the drill. Whenever the drill is removed to clean out the cuttings, a small piece of wax should be inserted.

Woodworkers may find their drills too soft for the harder metal parts of stagecoach models. One way to harden the drills sufficiently is to hold them with pliers, heat them until red (not white) hot, and then shove them into a box filled with tallow. If larger than 1/16 in., the drills should be kept in the unmelted tallow until cold. The point will be hard and the shank tough, and no tempering is required.—H. CALDWELL.

Where to Look for Other Mechanical Articles

MANY short articles of interest to mechanically minded men are scattered through the magazine in the sections preceding the Home Workshop Department. If you happen to have missed any of the following, it will pay you to turn back to the pages noted and read them.

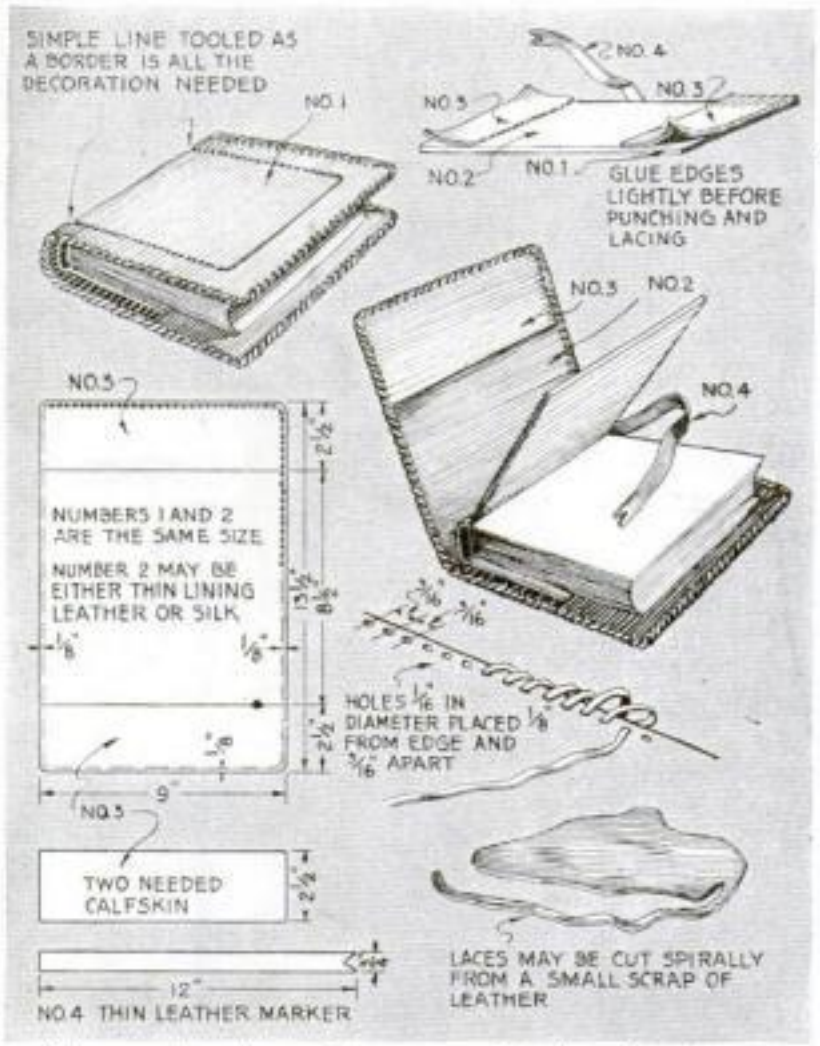
TO TURN a tight fruit jar cap, run a wide rubber band around it and another around the base of the jar, at the points where you grip each. The bands hold these surfaces like a pipe wrench and, at the same time, form a soft, nonslipping contact with your hands. In the absence of wide rubber bands, small ones or any other scrap rubber such as part of an old rubber apron will help.—WORTH STEWART.

Tooled Leather Book Cover

By F. CLARKE HUGHES

LEATHER, because of its durability and beauty, is an ideal material for making a removable book cover.

A 9 by 13½ in. piece of calfskin (tooling calf preferred) is used for the outside covering, marked No. 1. This makes a cover large enough for the average novel or textbook. Two pieces of the same stock 2½ by 9 in. will be needed for the inside end pieces. The lining leather, marked No. 2, should be the same size and shape as No. 1, and may be either thin lining kid, calf, or ordinary silk. The marker, No. 4, is cut to shape from a ¾ by 12 in. piece of thin leather.



The cover is made up of five pieces. Note how the edges are laced and method of cutting the laces from scrap leather.

The decoration on the cover may be anything in the way of a simple design; however, it is suggested that a simple border line such as shown in the illustration be used. This may be tooled or pressed into the damp leather with a very blunt-pointed tool or awl used against the edge of a ruler. The tool should be smooth and polished on the working end. A soft, blunt-pointed lead pencil may be used if a dark colored line is not objectionable.

Assemble the various parts and punch the holes as indicated with either a regular leather punch or a nail filed flat on the end and used on the end grain of a block of wood. The lacing can be cut ⅛ in. wide from scraps of leather—preferably kangaroo or wallaby skin. Lace the edges with a simple spiral stitch.

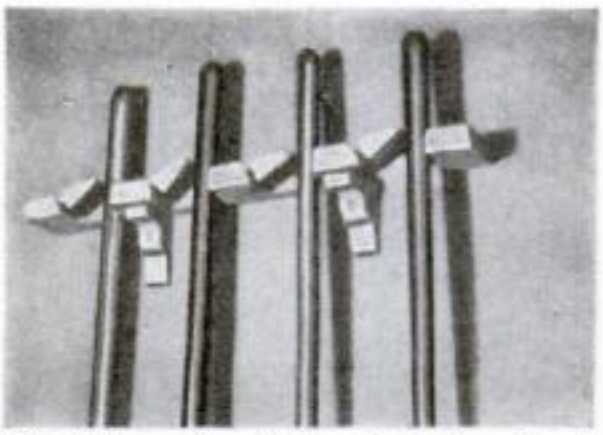
When entirely assembled, the cover should be polished with floor wax.

Automatic Holder Grips Broom Handles

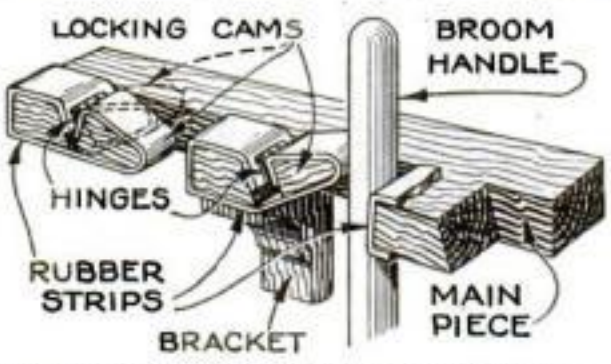
WHAT my wife wanted was a place to hang brooms and mops, so I made the automatic holder illustrated, tested it, and triumphantly called her to behold a gadget that really works.

The main piece of the holder is a strip of wood ¾ by 2¾ by 17¼ in. with four notches, each 1½ in. deep. The notches are cut in straight at the right-hand side but at a slight angle at the left-hand side, as shown, so that while each notch is 2⅝ in. long at the top, it is 2⅜ in. long at the bottom. The notches are 1¼ in. apart.

The locking cams are 1¼ in. long, 1⅜ in. wide, and ¾ in. thick where they are hinged. They taper to a rounded edge as indicated.



The holder automatically grips the handles of the brooms and mops at any point desired.



The movable cams and the stationary pieces are covered with a ¾-in. strip of inner tubing.

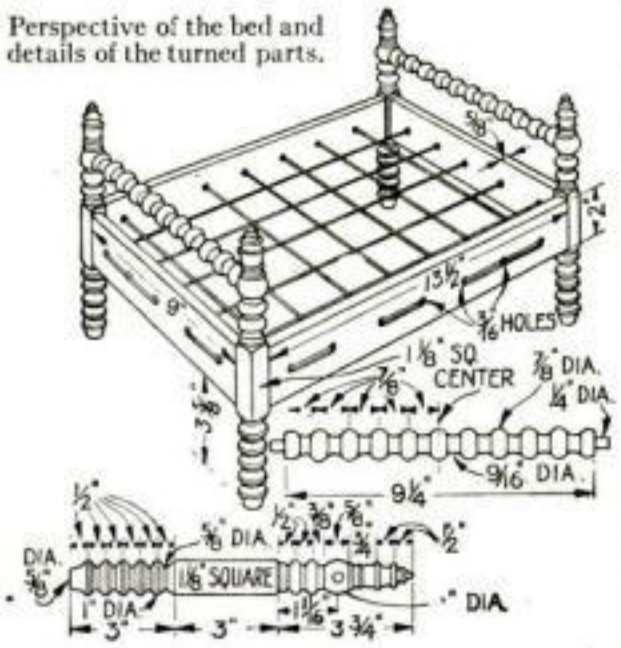
When the cams are hinged, the ends of a 1¼ in. wide strip cut from an old inner tube are fastened beneath the flaps of the hinges and are held in place by the screws. This free loop of rubber is then stretched around to cover the locking cams and the projections as illustrated. The holder is screwed to the wall and reënforced with two ¾ by 2¾ by 2¾ in. wooden brackets placed under the second and fourth stationary projections.—R. P. GRANT.

Colonial Doll Cradle and Four-Poster

WOODWORKERS who delight in copying old furniture will find that the doll's cradle and bed illustrated are interesting projects in early American construction and design. Both drawings were taken from pieces made in the early part of the nineteenth century as miniature copies of the full size furniture of that period.

Soft white pine is used in the construction of both toys, and a dark brown

Perspective of the bed and details of the turned parts.

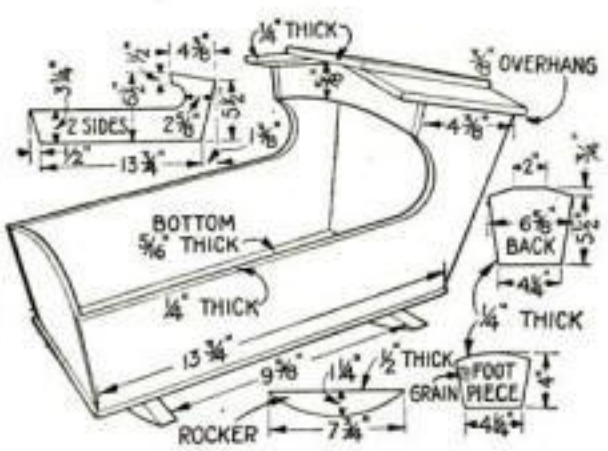


stain and two coats of varnish are all that are required for the finishing.

With the exception of the bottom board and the rockers, ¼-in. stock is used throughout for making the cradle. The front and backboard are first nailed and glued between the sides, and then the bottom is fastened in place. Next, cut the hood pieces to shape and nail them on top of the sides, and then fit the curved apron. Rockers made from ½-in. stock are nailed and screwed in place from the inside of the cradle. Sandpaper the entire piece, carefully rounding all the edges.

The bedposts and upper crosspieces for the doll's bed can be turned in the lathe from 1⅛ in. square stock. It is also possible to make them by gluing small wooden spools on 3/16- or ¼-in. dowels. The lower cross rails are fitted to the corner posts with short ¼-in. mortise and tenon joints.

Drill a series of 3/16-in. holes in the lower rails and through these lace the cord as shown in the drawing. This method of supporting the mattress was used in many old bedsteads.—F. J. B.



Assembly view of the cradle and dimensioned views of back, sides, rockers, and foot piece.

How to Make Cork Bodied Lures for Bass and Trout

By ROBERT PAGE LINCOLN

CORK bodied lures for use in fishing for trout and for small-mouthed bass and its more common cousin—the large-mouthed variety—can be easily made by the sportsminded home workshop enthusiast.

Ordinary bottle corks will not answer the purpose, but high-grade cork can be purchased from any large sporting goods establishment or tackle maker. Fine

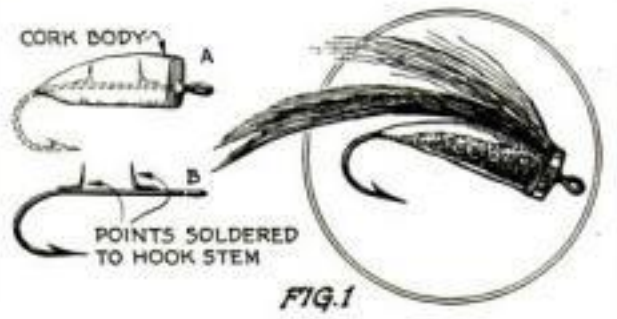


FIG. 1

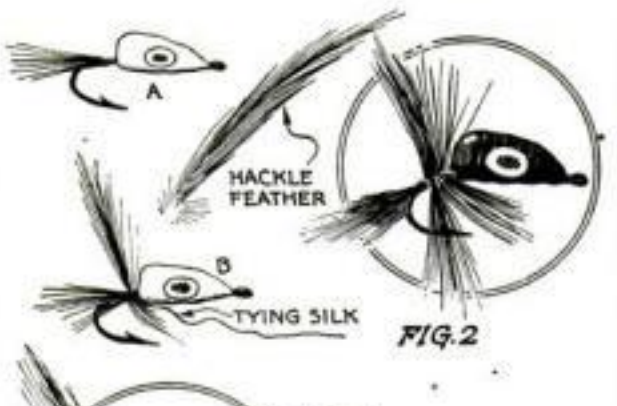


FIG. 2

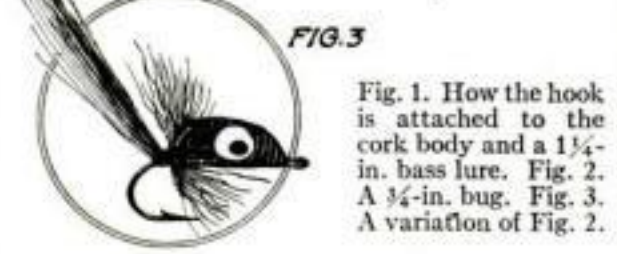


FIG. 3

Fig. 1. How the hook is attached to the cork body and a 1¼-in. bass lure. Fig. 2. A ¾-in. bug. Fig. 3. A variation of Fig. 2.

quality cork is not only very tough but its buoyancy is far greater than that of cheap cork.

Bass bugs can be made any size desired, ranging from a No. 6 to a No. 1–0 hook. The so-called O'Shaughnessy hook, hand forged and filed, is probably the best suited for the work. Most fly makers in preparing the cork body of the bass bug simply cut a slit lengthwise on the underside of it, press the shaft of the hook into it, and then wrap the entire body with silk thread. This does not, however, prevent the cork body from turning on the stem of the hook. My own method, as shown in Fig. 1, suggests soldering two pieces of wire at right angles to the stem of the hook. The size of these pieces is governed by the size of the body of the fly; on a No. 1–0 hook they are ¼ in. long.

In attaching the cork body to the hook stem, cut a slit along the underside of the body and press the hook stem up into it. The points will drive into the cork and hold the body in place.

The lure shown in Fig. 1 is 1¼ in. in length and ⅞ in. thick at the head. This fly is painted over with regular artist's

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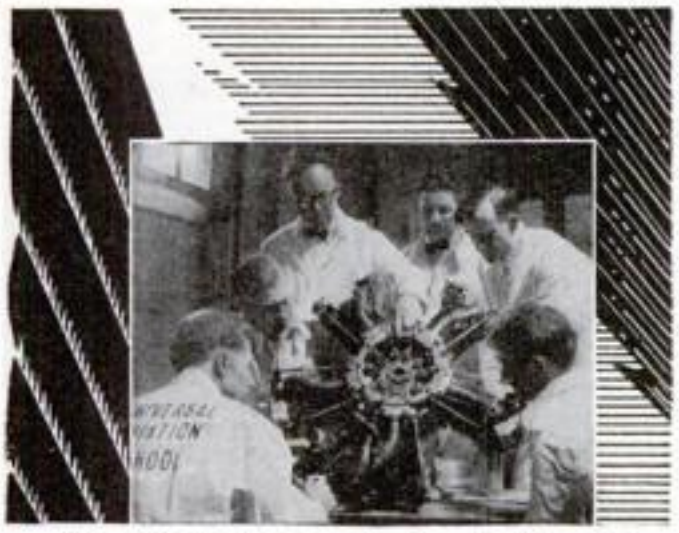
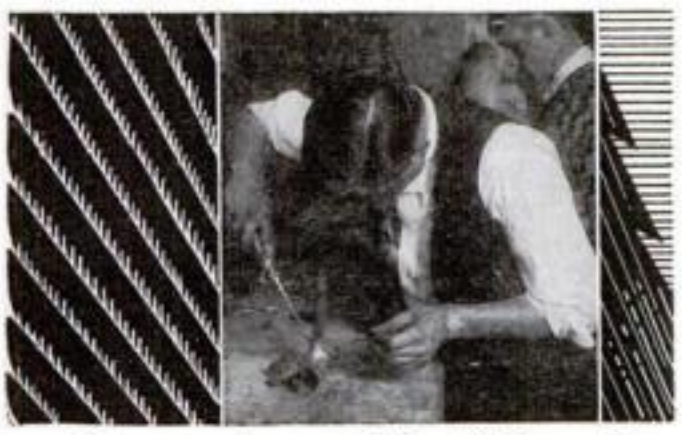
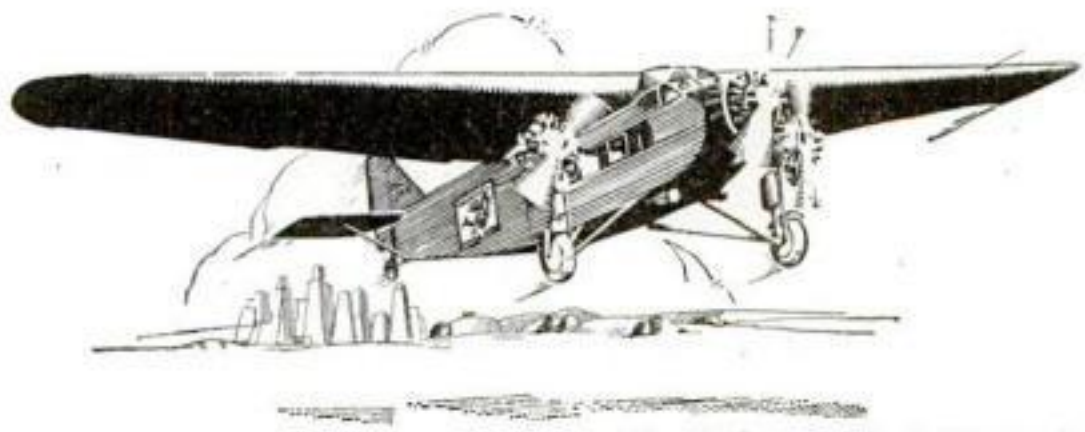


Practical shop work in a Universal School.



Many graduates of the Universal welding course are employed at good pay in airplane factories.

A typical class room in one of the schools of this national system.



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paint; and two hackle feathers 3 in. long are tied on so that they lie over the back of the fly. A wisp of white bucktail is placed on each side of the feathers. Waxed thread should be used for all tying operations.

If desired, the fly body can be coated with a high-grade waterproof varnish such as fly makers use, and the body dusted with gold or silver crystals obtainable at any large art store. The varnish dries and holds the crystals, which produce an attractive sheen.

The bass bug shown in Fig. 2 has a body ¾ in. long and ¾ in. in diameter. This lure, being small, can be used for trout. The top of the body is rounded,

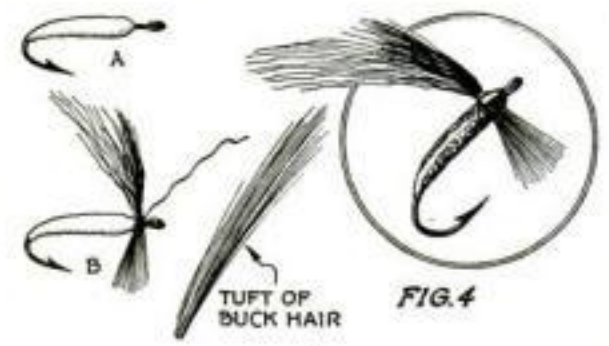


FIG. 4

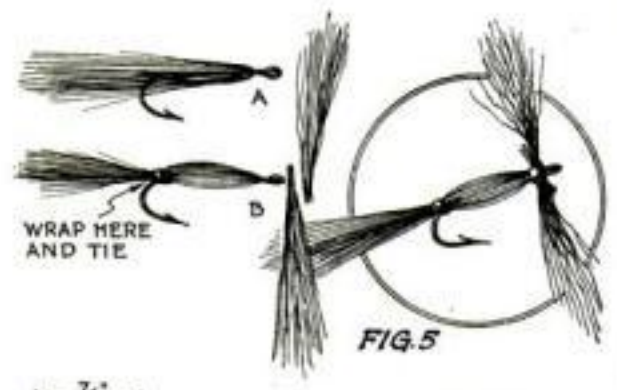


FIG. 5

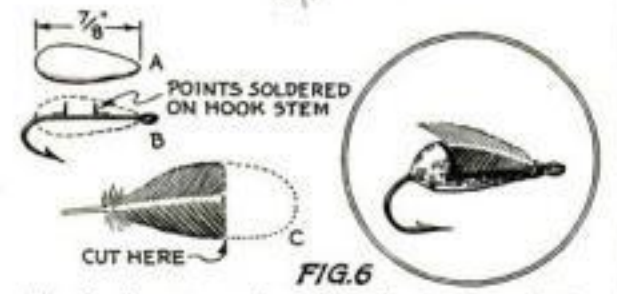


FIG. 6

Fig. 4. A wet type bass fly. Fig. 5. A squirrel-hair lure. Fig. 6. An imitation moth trout fly.

but the underside is made flat. The body is attached to the hook in the manner described above and is placed so that there is at least ¼ in. between the end of the body and the beginning of the bend of the hook.

A tuft of squirrel hair is tied in as a "tail," the forward half of it being thrust down under the body of the bug. A hackle feather with filaments 1 in. long is caught in and wrapped around the tail just back of the body. This fly, when dropped on the water and moved the very slightest bit, throws every filament of the hackle feather into action, giving it life that causes even the wisest bass to strike.

Only the fact that the body of the bug is 1 in. long and ½ in. wide and that it has a tail hair tied in such a manner that it stands up at an angle makes the lure shown in Fig. 3 different from that shown in Fig. 2. The writer has landed ten bass in one afternoon with this type of lure.

Figure 4 is a bass fly of the "wet" type; that is, it is operated under the surface of the water. A tuft of squirrel hair is tied in as shown to represent the wings of the bug. The thicker portion (or butt)

of the nip of hair is allowed to stand down below the head. Then, by wrapping the thread backward and up, the tuft is turned back. The value of this tuft of hair underneath is that it acts as a weed guard.

A SIMPLE but effective hair fly is shown in Fig. 5. It is made by tying in a tuft of squirrel hair (cut full length from the tail of the animal) at the head or eye of the hook. Wrap a small amount of waxed thread around the hook before you tie the hair in place, so that the tuft will not turn; fasten the hair in place and then gather the hair in and tie it near the bend of the hook as shown. Instead of outstanding wing feathers, use a nip or two of buck hair, turning the ends out on either side, butt ends of the hair in. Now tie these two tufts in place by crisscrossing the thread back and forth. Finally, touch the head with fly-maker's waterproof varnish.

This fly is cast like a dry fly and, if possible, to the exact spot where a fish has made a swirl in the water. It settles on the water and will float for a few moments. Then it is picked up and dried by false casts in the air before being returned to the water elsewhere.

Figure 6 shows what can be done with a small cork body and a No. 8 hook in making a floating trout fly. Varnish the body of the fly with two or three coats of fly-maker's varnish. While the last coat is still tacky, the body is dusted over with silver or gold powder. To give the fly the semblance of a moth (which this aims to imitate), cut rabbit fur almost dust fine and sprinkle this on the varnished body. When the varnish dries it will hold the fuzz and colored crystals in place.

The body top should be sloped to hold the wing feather at the proper angle. The wing is simply the butt of a feather tied in securely at the head. This fly will account for big rainbows, also brook trout. It is a big killer on sunfish, and is unequaled when fished where "croppies" are known to hide.

ALL of the various types of bass bugs are manipulated in the same manner. They are cast out on the water and allowed to remain motionless for a few seconds; then they are moved forward a few inches and again allowed to remain motionless. This is repeated three times. If no strike is felt, the rod is given a few twitches in order to set the hackle filaments in motion; and if still there is no strike, the lure is picked up and cast elsewhere. With a little practice it is possible to impart lifelike movements to this type of lure.

To aid you in your fly tying, you will find a watchmaker's vise very handy; in fact, almost indispensable. You can obtain a simple little vise in a five and ten cent store that will likewise serve the purpose.

Ordinary high-grade silk thread coated with shoemaker's wax will do for tying flies.

In preparing the hair, feathers, and hackles, it is well to do all of the dyeing at one time and to have a sufficient supply of everything on hand before the work is begun.

Three-Sided Bird House Has Many New Features

By GEORGE SHARP

REACTING to the breeze like a small weather vane, the bird house illustrated turns with the wind and keeps its entrance always on the lee side. Though primarily intended as a wren house, a few alterations in the dimensions will make it adequate for birds of any size.

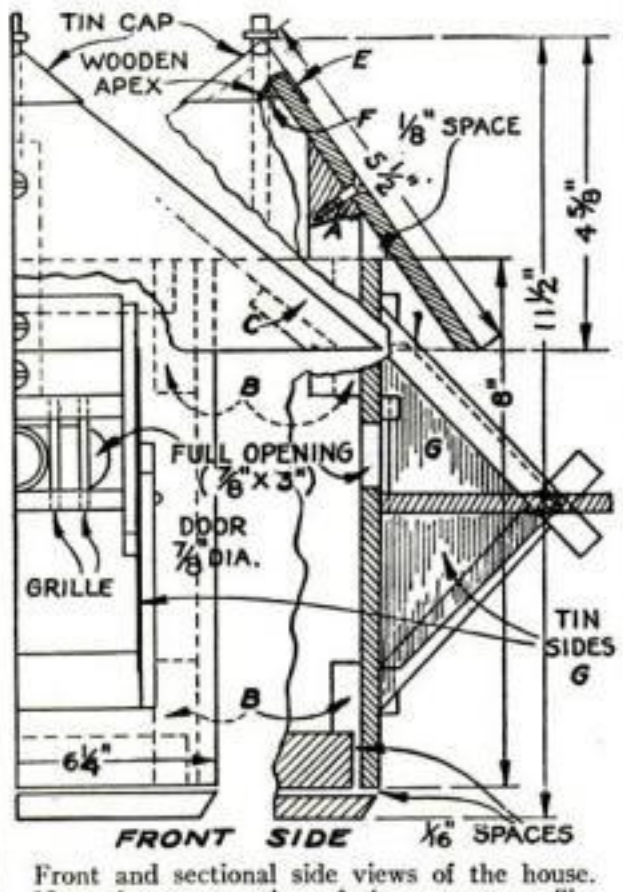
Unlike many wren houses, it has an opening that is fully large enough for the wrens themselves to enter and bring with them the material that they use to build their nest, but too small for any other bird. Just outside the door is a porch or platform. Since it is shielded with the tin sides *G*, it is well protected from the wind. The tin also serves as a vane to cause the house to turn in the wind.

The house is hung on a brass chain.

The sides of the triangular house are made from ¼-in. stock; they are 8 in. high and 6¼ in. wide. The three pieces that form the roof can be cut from the same stock to the shape of isosceles triangles having bases of 11 in. and heights of 5½ in.

The sides are mitered so that they fit together snugly, and reënforcing blocks *B* are placed in the corners. Roof supports *A* are placed in the middle of each side. The roof pieces are held together with corner pieces *C*.

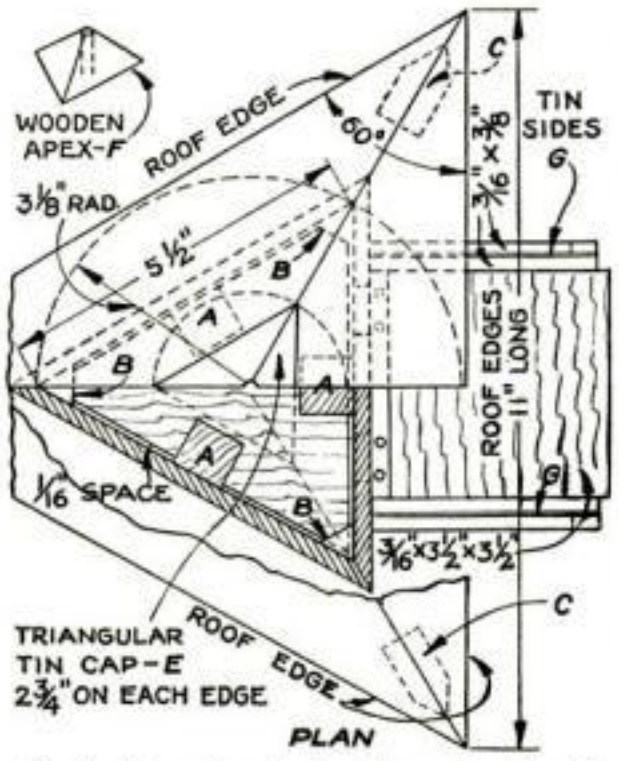
A 1/16-in. space around the top and bottom pieces form a drain for any rain



Front and sectional side views of the house. Note the construction of the entrance grille.

water that may get into the house. Under the main bottom piece, another triangular piece is placed. This acts as a damper and is not screwed up flush with the bottoms of the sides (see drawing at bottom of page 120).

The grille at the 7/8 in. by 3 in. opening is made of wire and is set in the porch and the rectangular strip over the opening



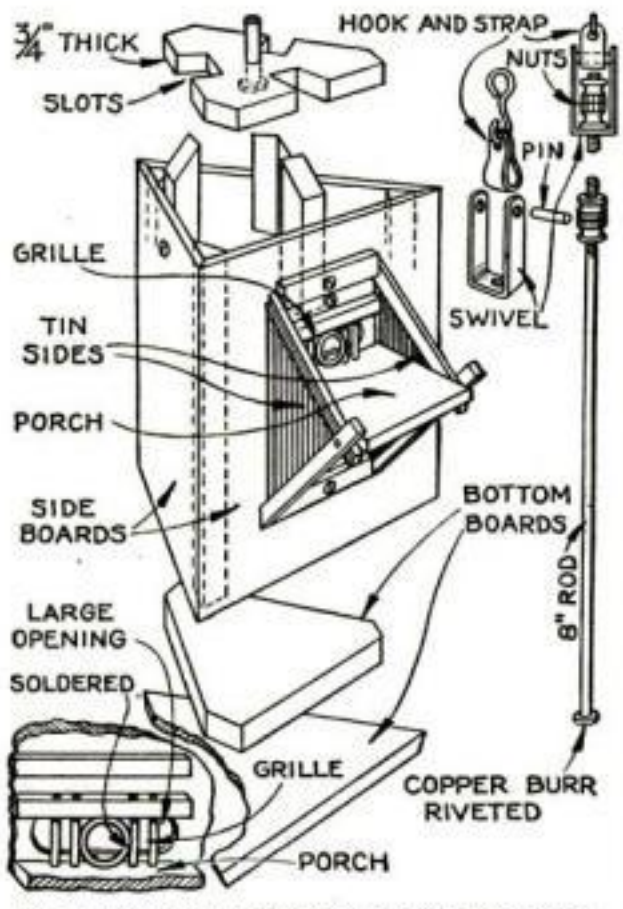
Sectional top view showing the construction of the roof and a perspective view of the apex *F*.

(see the drawing at bottom of the page).

An 8-in. rod, threaded at one end to receive two dry cell nuts and riveted over at the other, is passed through a hole in the top piece and through a 22-caliber shell soldered to the tin apex at the top of the roof as shown in the lower drawing on page 120.

If intended for bluebirds, the house should be made 10 in. high and the opening should be 1½ in. wide instead of 7/8 in.

In hanging the house, the bottom should be at least 6 ft. from the ground; and if children are frequent visitors, at least 8 ft. should be allowed.



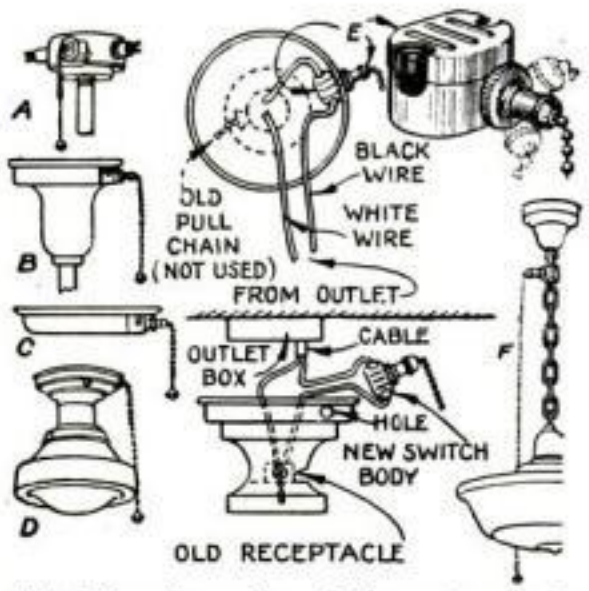
Perspective view of the body of the house and sketches of the grille, rod, swivel, and hook.

THE SHIPSHAPE HOME

Electrical Helps for Handy Men

A raspy, grating noise is caused by pulling the chain to light one of those white kitchen units placed near the ceiling. How can it be avoided?

INSTALL a switch of the type shown. The noise is caused by the use of a pull-chain receptacle within the fixture, and its chain comes out of a hole which is not smoothly bushed. To install the new switch, pull the old chain to the "on"



Switch *E* can be used in outlet boxes *A*, canopies *B*, ceiling pans *C*, and office and store units *D*. Another type *F* is for use on chain fixtures.

position and cut it off close to the fixture. Loosen the fixture from the ceiling, and at a point in the side of the fixture near the top you will find a "knockout," which may be pushed in with a screw driver. This leaves a hole for the new switch, which is connected in series as shown by cutting the black wire, if the wires have colored coverings. The switch cover is then replaced, the knurled ring unscrewed, the end pushed through the hole, and the ring screwed on, clamping the switch in place. Refasten the fixture to the ceiling. Other uses for the switch are suggested in the drawings above.

Is it possible to obtain a surface-type toggle or tumbler switch?

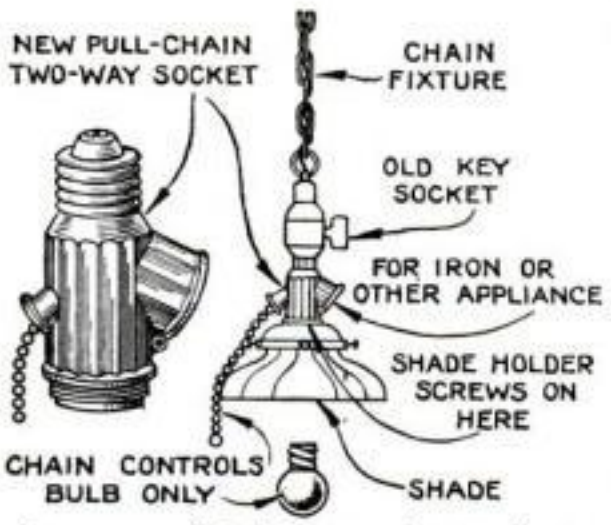
A new type of surface switch.

Yes. When it is necessary to use a surface switch in a new installation or when an old surface snap switch has to be replaced, it is well to use one of the new surface-type toggle switches illustrated.

What are the advantages of the new screw-base two-way sockets with a pull chain?

It is especially useful where a key socket is at present used on a fixture and an

iron or other appliance is connected in addition to the light. The pull chain makes the operation of the light much more convenient, since it is independent of the tap on the side for the appliance (see illustration below). The tap is always "on." A standard shade holder may be screwed on the bottom of the socket, making it possible to use the old shade.



A two-way pull-chain screw socket supplies a socket for a bulb and one for an appliance.

How can the fraying of a used appliance cord be prevented at the point where it is grasped just outside the plug cap?

By using the newer handle type of attachment plug cap shown below. When a wall receptacle is new, it is often hard to remove the cord because of the tight spring contacts. Repeated pulling on the cord often results in crossed wires in the cap contacts. It is easy, however, to change to the new handle type plug by loosening the screws in the old cap, untying the knot (if one exists), and removing the cap. Slip the new one over the cord, tie an Underwriter's knot, and make the bared ends of the wires fast under the screws.

Handle plug eliminates fraying of the cord.

What is the simplest way to make an extension from a base or wall receptacle to another outlet or light in a new location?

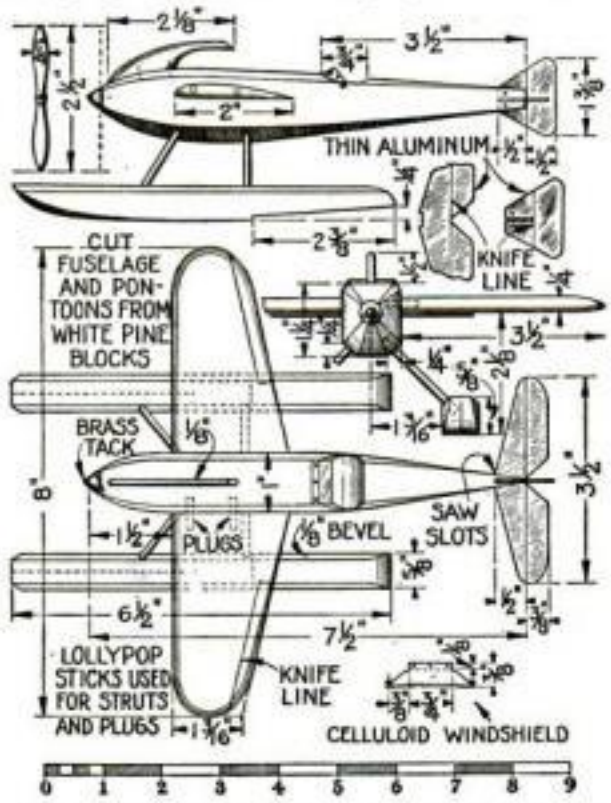
The usual way is to carry the BX cable from the new outlet to the box housing the old receptacle, and to splice, solder, and tape the joints. By means of the new receptacle shown at the bottom of the page this work is saved. The receptacle provides a regular terminal block, and it is necessary only to connect the wires of the same polarity (say black wires) under the screws on one side of the plug. The white wires then are connected similarly on the other side. This type of wall receptacle is valuable to the home worker who is without a soldering outfit.—HAROLD P. STRAND.

The new branch block plug wall receptacle.

New Toy Model of Racing Seaplane

TOY model airplanes, copies of real ships of the air, can be made from scraps of soft wood, a few lollypop sticks, and some thin sheet metal. The plane illustrated is one of the most modern of aircraft—the high-speed seaplane.

White pine is probably the best wood for the construction of the fuselage, pontoons, wings, and exhaust pipe, but any soft, straight-grained wood will serve. The struts and wing plugs are made from lollypop sticks, and the propeller and tail



Assembly views of the toy racing seaplane. The propeller and tail units are made of thin metal.

unit are cut from thin aluminum or other thin sheet metal.

The windshield, in front of the cockpit, is made of thin sheet celluloid, or of metal if the celluloid cannot be obtained.

Make the wings in one piece from a ¼ by 2 by 7 in. blank and cut the piece in half after it has been brought to shape.

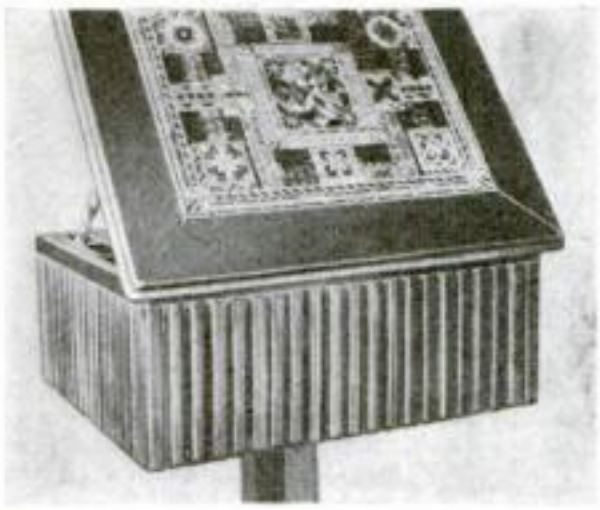
The fuselage and pontoons can be painted a light blue, the wings and tail cream, and the propeller and exhaust pipe black.—DONALD W. CLARK.

Hints on Applying Paint on Metal Surfaces

GUTTERS, downspouts, and the like should not be painted until particular care has been taken to remove all rust, scale, and dirt with a wire brush, putty knife, and sandpaper, and by scrubbing with kerosene, if necessary. It is important to remove all rust, for rust will eat its way through the paint.

New galvanized iron and tin is always covered with a greasy film, to which paint will not adhere properly. The surface should be washed thoroughly with vinegar, which will remove this oily substance. For the first coat, red lead or some other metal protective paint, or a specially prepared galvanized iron primer, should be used. The following coats may be of any good outside house paint of the desired color.

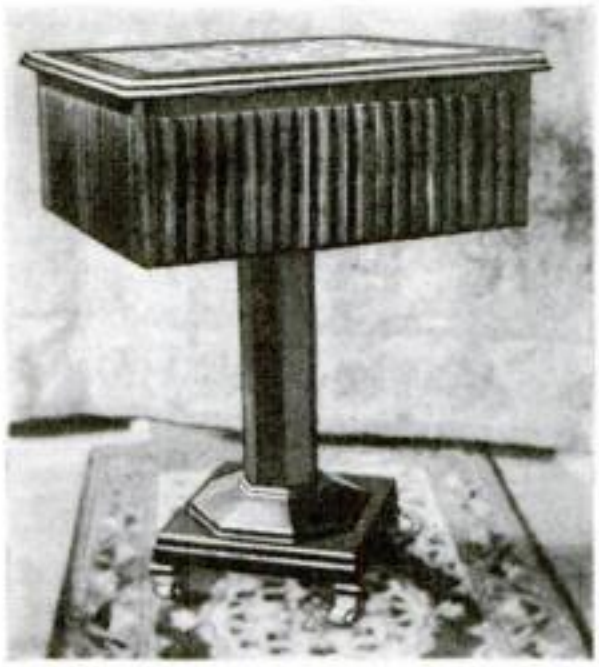
Builds Modernistic Worktable



The top raised to show the remarkable inlaid design made from fourteen California woods.

THIS beautifully inlaid modernistic worktable was built by A. L. Brown, of Paso Robles, Calif., from plans given in an article "Sewing Table in Modern Style," by H. J. Roskyl (P.S.M., Apr. '29, p. 78). The cabinetwork and the inlaying were done entirely by hand from trees and shrubs grown in the vicinity of Paso Robles, the wood being cut green and sawed from the rough.

The top, pedestal, and base are made from two contrasting woods—manzanito and what is commonly known as California holly. The inlay consists of fourteen varieties of wood.



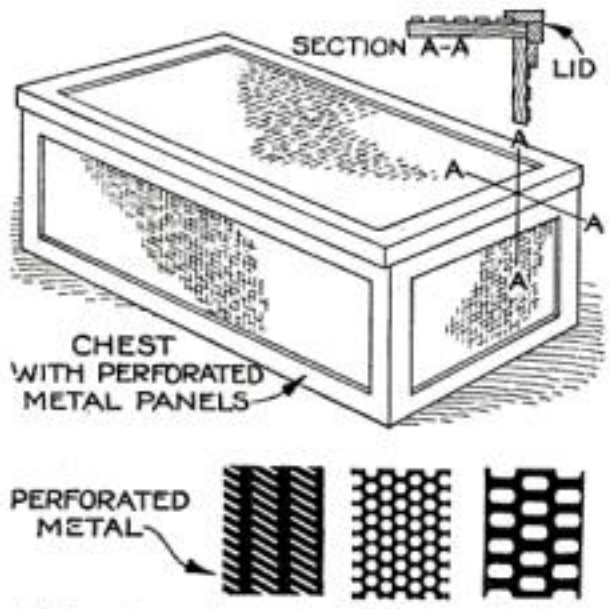
A. L. Brown, of Paso Robles, Calif., built this table from POPULAR SCIENCE MONTHLY plans.

The finish is clear brushing lacquer, which brings out the natural beauty and figure of the grain of the different woods. So clear and smooth is the finish that it seems to have an odd attraction for all those who see the piece for the first time.

WHEN assembling machinery or apparatus which has the head of a bolt or machine screw on the outside and the nut in an awkward position on the inside, the nut can be started without much trouble provided you can reach the place with a finger. Wet the finger tip with shellac, let it become tacky, and stick the nut on the shellac. It is then possible to reach in and hold the nut until the screw has been started.—ARNOLD W. REITZE.

Perforated Metal Sheets Useful in Craft Work

PERFORATED metal is a material which can be used in many ways by home workers. It may be bought in sheets of steel, brass, copper, bronze, zinc, lead, tin, and aluminum and in almost any size and in any thickness from .03 to .375 in., although, of course, only the lighter weights are useful for amateur work. The perforations are of many



Design for a chest with decorative aluminum panels, and three patterns of perforated metal.

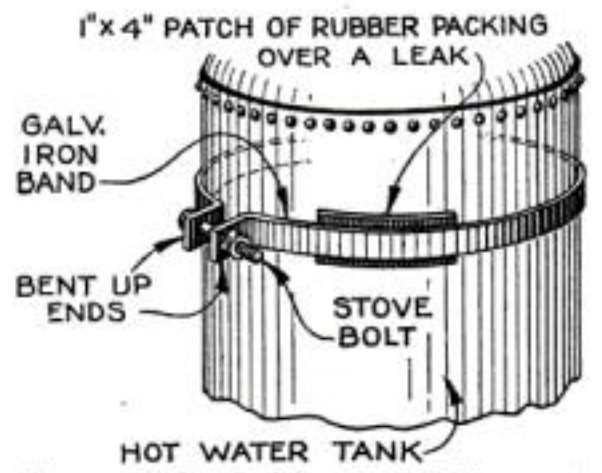
shapes, of which three common varieties are illustrated.

The lighter metals and sheets may be used as panels for fire and porch screens, for radiator cabinets or shields, and for plant boxes, waste baskets, chests, and wood boxes.

As a panel for the chest illustrated, for example, aluminum, with its silvery texture, if backed with well-chosen silk or other material, would make a light and distinctive looking storage place for linen or bedding.—DAVID WEBSTER.

Repairing a Water Tank

SMALL leaks in hot water storage tanks can be quickly repaired in the manner illustrated. Measure the distance around the tank, add 1½ in. to this, and then cut a strip of galvanized iron to that length.



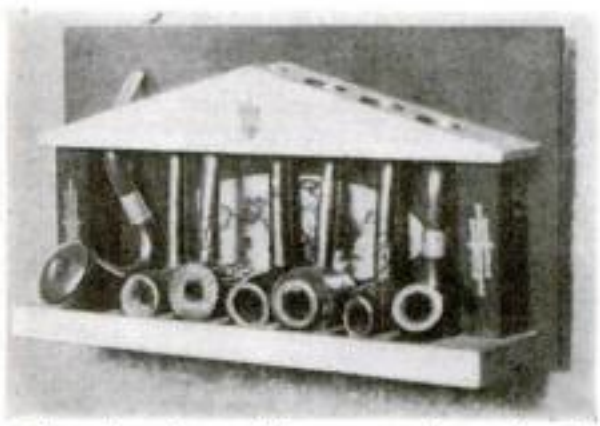
A narrow galvanized iron strap holds a small patch of thin rubber over the leak in the tank.

Drill a ¼-in. hole ½ in. in from each end of the strip, bend the ends up so as to form 1-in. ears, and bolt it around the hot water tank after covering the leak with a 1-by-4-in. piece of rubber cut from an old inner tube. Draw the bolt up very tight.—WILLIAM A. CEROW.

Neat Smoker's Rack for Holding Pipes

SMOKERS who prize their pipes can display as many as seven of them in the compact and ornamental rack shown below. It can be constructed with few tools and from any odds and ends of wood.

The plywood back *A* measures 3/16 by 7¾ by 14 in. and is braced with two ⅜ by



The rack can be made from scrap pieces of wood and lacquered to suit the individual taste.

¾ by 7 in. hardwood cleats, which are fastened with flat-headed screws.

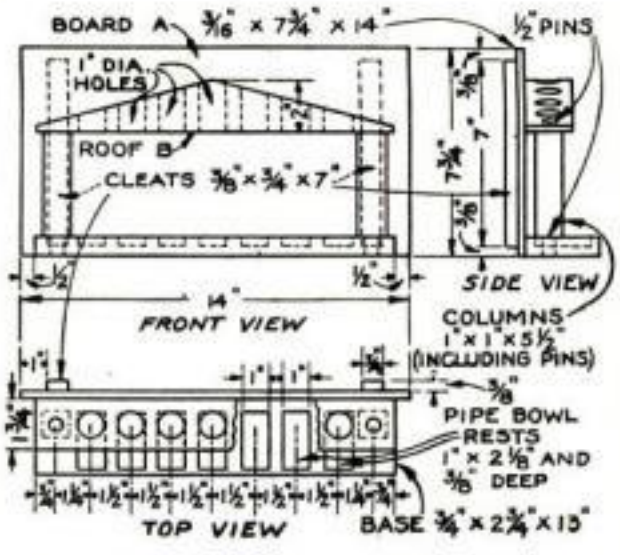
Draw center lines on the top and bottom surfaces of a 1¾ by 2 by 13 in. piece of stock for the roof *B*. Beginning in the middle and working out to both ends, lay out the centers for the 1 in. diameter holes as indicated in the drawing at the bottom of the page.

The base, which is ¾ by 2¾ by 13 in., should have seven recesses cut to a depth of ⅜ in. in its upper surface. These can best be shaped with a chisel.

The columns are 1 in. square and 5½ in. long, including two pins on the ends, which can be cut easily with a pocket-knife. These pins are ¾ in. long and ½ in. in diameter.

Assemble the top, bottom, and two columns, and fasten the columns by driving wooden wedges into saw cuts in the tops and bottoms of the pins. Attach the back with brads and glue.

In finishing, the writer used red lacquer for the inside of the holes and the recesses in the base; dark blue for the top and bottom; black for the columns; and dark brown for the back. In the center of the exposed back a decalcomania transfer was placed. Small hand painted decorations were placed on the front faces of the two columns.—WILLIAM C. CLARK.



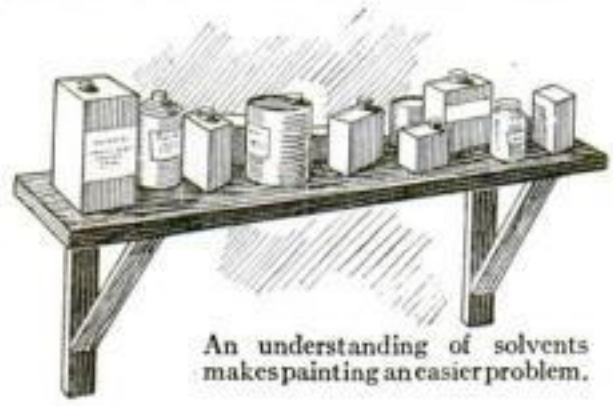
Dimensions of the pipe rack. The pins on the columns are ¾ in. long and ½ in. in diameter.

Painting Simplified by Correct Use of Solvents

By BRUCE BRIGHTON

PROBABLY no one thing is of greater help to the home painter or does more to make painting an interesting and profitable occupation than to realize that the various paint, varnish, and lacquer materials have certain solvents, through the proper use of which paint may be removed from any surface or may be thinned to a more satisfactory working condition for application. Following is a brief description of these solvents, which may be readily obtained in every locality, together with a summary of their uses and advantages for different purposes.

One of the most extensively used paint solvents is turpentine. This is obtained from pine and other cone-bearing trees, the greater part of the world's supply coming from the pine forests of the South Atlantic states. A fluid extracted from



An understanding of solvents makes painting an easier problem.

the tree by cutting an incision in the bark and sap wood is distilled to produce the commercial spirits of turpentine.

Turpentine may be used for reducing any paint, varnish, or enamel of the oil type. It not only reduces the paint mixture to thinner consistency but, as it evaporates slowly, it makes quick-drying materials easier to work, since it slows up the drying.

Turpentine may also be used for general clean-up work of all kinds. It is not, however, a powerful enough solvent to remove paint that has become thoroughly dry and hardened. It is used extensively for cleaning grease and oily furniture polish preparations from surfaces to be refinished; also for removing wax from floors, woodwork, and furniture before refinishing; and for washing off the surface after the use of paint remover.

In this process, the surface should be scrubbed out with a vegetable or scrubbing brush dipped into the solvent, and then sandpapered until dry. (For the foregoing purposes, however, alcohol will be found more satisfactory, as it cuts grease and wax more effectively, and leaves the surface in better condition for refinishing.) Turpentine may also be used for cleaning spattered or daubed woodwork, wiping off spoiled or faulty work, removing paint from clothing, rugs, and for cleaning the hands. In

A definite program for getting ahead financially will be found on page four of th's issue.

cleaning brushes, however, it should be remembered that shellac brushes should be cleaned with alcohol, and lacquer brushes with lacquer thinner, as turpentine is not a good solvent of shellac or lacquer.

BENZINE, naphtha, and gasoline are all in the mineral spirit group, or what are generally known as petroleum distillates. They are derived by the distillation and further processing of the crude oil as it comes from the well. Benzine is drawn off first, being produced at the lowest degree of heat or boiling point. A certain amount of the distillate is drawn off and then at a further degree of heat naphtha is drawn off; and so on. (It may be of interest to know that kerosene, paraffine oil, and lubricating oils are also of the same group, being drawn off at varying degrees of heat, as is also petroleum jelly, commonly called "vaseline.") Solvents of this group are more highly volatile, or, in other words, evaporate more quickly than turpentine.

All more or less alike in their general characteristics, benzine, naphtha, and gasoline, insofar as the use of the average home painter is concerned, are more or less interchangeable. They may be used for reducing certain paint, varnish, enamel, and stain materials with satisfaction; turpentine, however, is more nearly foolproof and a better all-around thinner, and is therefore recommended for general purpose home requirements.

Benzine, naphtha, and gasoline are especially adapted for clean-up purposes. They are unexcelled for cleaning off woodwork, removing wet paint from clothing and rugs, cleaning the hands, and similar purposes, and may be used with entire satisfaction for cleaning brushes, with the exception of those used for shellac or lacquer. Gasoline, being cheaper and more readily available than benzine or naphtha, is the ideal material for the amateur painter to use. High-test gasoline, which is distilled at a higher boiling point than the "regular" gasoline, is, of course, a more powerful solvent, and is to be preferred even at its slight additional cost.

ALCOHOL is an entirely different type of solvent than either of the above groups. The kind used for painting purposes is produced from grain by a distillation process, which changes the starch and sugar content of the grain to alcohol.

Ordinarily alcohol is used for reducing shellac. It is especially adapted to this purpose, as shellac is nothing more or less than shellac gum dissolved or cut with alcohol. Alcohol is also generally used for cleaning brushes that have been used in shellac. (Turpentine and gasoline as previously stated, cannot be used for this purpose, as they merely shrivel up and harden the brush.) Alcohol is one of the most satisfactory solvents that can be used for removing wax from surfaces to be refinished, cleaning off greasy deposits before refinishing, washing off the surface after using paint and varnish remover, and the like. It is desirable that alcohol be used for these purposes when lacquer is to be used for refinishing. In using

any of the new quick-drying lacquers, the use of lacquer thinner is an absolute necessity. This is essentially a product of the alcohol group, being, in brief, alcohol treated with acetic acid to produce a water-white liquid having a bananalike odor.

LACQUER thinner is a very high-powered solvent, and, as it will quickly cut into previously applied finishes that have become thoroughly dry and hard, much care should be taken in its use for general clean-up work. It is, however, the ideal material for cleaning lacquer brushes as well as for cleaning the hands after the use of lacquer or for cleaning spilled or spattered lacquer from clothing and rugs. It may be used with thorough satisfaction for removing an old lacquer finish from any surface where so desired for refinishing. Being also a powerful solvent of the oil type paints, varnishes, enamels, and stains, it is sometimes used for removing painting material of various kinds that have become hard, as well as for cleaning paint and varnish brushes. Naturally, lacquer thinner is designed primarily for reducing lacquer, and should be used for this purpose wherever thinning is found to be necessary.

None of the foregoing solvents are sufficiently powerful for the complete and clean removal of old paint or varnish finishes so that the surface may be properly refinished. For such requirements, an extremely high-powered, slow-drying type of solvent must be used. While different materials may be used for this purpose, some of them will burn or otherwise injure the surface for refinishing; others are so high-priced as to be impracticable.

The removers in most general use at the present time are of the benzol type made chiefly from benzol, which is a coal tar product with certain other materials added and so treated as to prevent rapid evaporation. Most of the products supplied by paint stores under the name "paint and varnish remover" are of this type.

These paint and varnish removers are ordinarily applied to the surface and allowed to stand for a few moments to soften the old finish, after which the old coatings are scraped off with a putty knife. As previously explained, it is all-important that the use of paint and varnish removers be followed by a thorough wash-up with turpentine, gasoline, benzine, or alcohol (preferably alcohol), and a thorough sandpapering to clean off all remaining deposits of the paint remover, which would otherwise prevent the drying of following finishing coats. Paint and varnish removers may also be used for cleaning brushes that have become hardened, as well as for softening and removing dry, hard paint from clothing, rugs, and other materials.

A WORD or two more about the use of solvents for thinning purposes, as there are a few general principles which, if observed, will enable the home painter and decorator to use them correctly and with the assurance of the best possible results—

In the first place, it should be fixed in

mind that where one thing is gained, something else is sacrificed in some measure. Therefore care should be taken to keep a balanced material. Remember that while enough is good, too much may be detrimental.

LET us take, for instance, the thinning of a flat wall paint with turpentine. Suppose the material is too heavy for easy brushing and shows brush marks. Some turpentine should be added, which will bring about easier brushing with freedom from brush marks. However, the turpentine will reduce the hiding power of the paint. Judgment should, therefore, be used in the thinning of paints so as not to reduce the covering power to too great an extent.

Turpentine tends to flat the finish, or in other words to reduce the gloss, and therefore only a small amount should be added to enamel, varnish, or other materials where a gloss finish is desirable. As a rule, thinning of these materials is seldom necessary, unless they have become thickened from standing. In the use of varnish, however, there is one exception to this general rule—first-coat work on new wood. Here ten to fifteen percent of turpentine should be added to help penetration into the new wood. On the other hand, the flatting nature of turpentine may be just what is wanted at times, and the addition of a small amount may be desirable to reduce the gloss of some over-glossy material.

In outside house painting, a slightly different set of principles is involved, on account of exposure to the weather. Here one of the main functions of a solvent thinner, like turpentine, is to help penetration of the paint material into the surface. An ample amount of turpentine always should be used in the first or priming coat on new wood, especially oily, hard or sappy woods; also in the first refinishing coat on two-coat repaint jobs. Some turpentine should also be used in the second coat of three-coat new jobs, to make this coat an extremely hard one. It should be remembered, however, that an excess of turpentine will cut down the body of the paint too much, and impair durability. For the last or finishing coat, very little, if any, turpentine should be used, as it will impair both the durability and appearance of the finish. Where the material is too heavy in consistency to permit satisfactory brushing, raw linseed oil should be used for thinning this coat.

Using a Paddle to Mix Paint Thoroughly

TO OBTAIN good results from any paint, it must be thoroughly mixed. Otherwise, the heavy pigment will go to the bottom and the top part of the paint will be too thin to give good results. A container of paint should be stirred to a uniform consistency immediately *before* and at intervals during application.

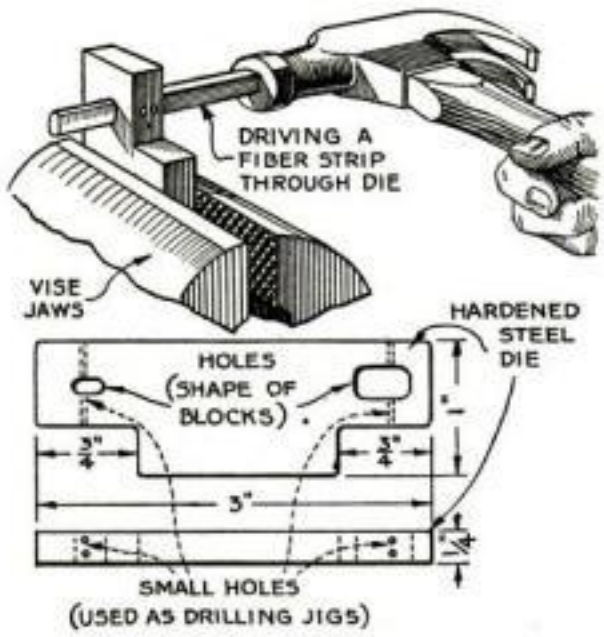
Stirring round and round does little good. A flat paddle should be used, starting with the end of the paddle at the very bottom and bringing it up through the paint with a turning, twisting motion.

Die Shapes Model Tackle Blocks

UNIFORM tackle blocks made of fiber for use on ship models can be quickly shaped with the steel die illustrated.

The die is made from a ¼ by 1 by 3 in. piece of tool steel. Cut the die holes to the size and shape of the blocks that are to be made. Drill two small holes at right angles to the die hole and slightly above its center. These holes serve as a drill jig for the sheave holes. Temper the working ends of the die and it is then ready for use.

While tackle blocks are generally made of wood, it was found that wood had a



Dimensions of the steel die and sketch showing how it is used. Note proportions of the block.

tendency to split when the sheave holes were drilled. Fiber answers the purpose perfectly and can be purchased at any dealer in machine shop supplies. Cut the stock into rectangular rods 6 in. long and of a minimum cross section. Taper one end of the stock so that it will fit into the die hole, and drive it through with a hammer (see illustration). After shaping sufficient stock in this way, pass the fiber through the die again and cut off the blanks to the proper length with a fine toothed hack saw.

Place the blocks back in the die and drill the sheave holes. The sheave grooves and grooves for the straps can be cut into the surface of the pulleys with a three-cornered file.

The straps and hooks on the blocks are formed from 1/32-in. copper wire. Cut the wire to the proper length, fit it in the side grooves, and wrap it around the block in the manner shown. In making upper blocks that are to be fastened to the end of the rope or fall, it will be necessary to provide loops at both ends.

When the blocks are completed, remove the sharp corners with sandpaper and dip the entire pulley in shellac or varnish.—H. L. WHEELER.

Woodworking Hints of a Veteran Craftsman

By HENRY GEORGE

MANY operations in the amateur woodworking shop can be greatly simplified if the worker will apply a few of the short cuts and labor-saving methods used by the professional carpenter and cabinetmaker during his day at the shop.

When driving nails or brads through one piece of lumber and into the edge of another, as when putting a box together, start the brads so that they will enter the edgewise piece close to the inside edge and on a slant that will keep them well within the thickness of the wood (see Fig. 3). This allows the full thickness of the wood in which to drive the nail instead of one half the thickness, as is the case when brads are driven straight down into the center. Another advantage of this method is that your nail or brad is not so likely to split the toppiece, being started farther back from the edge.

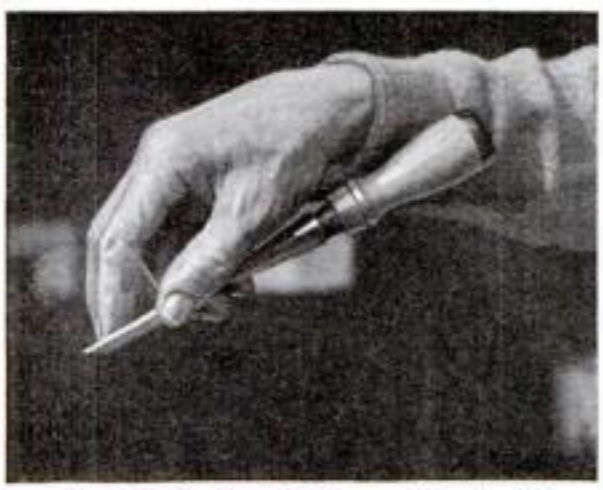


Fig. 1. In honing, grip the tool firmly with the finger tips only as illustrated above.

In finishing work in which the joints between the various pieces show, work some glue into the cracks carefully without getting more on the surface than is necessary; then, with fine sandpaper and a block, sand over the cracks until the wood dust has completely filled them. When the glue has hardened, clean the work with fine sandpaper around a block.

If your work becomes dented or marred, wet the depression and keep it moist until it has swelled up flush with the original surface. If the surface is filled with oil or varnish, as would be the case in finished wood, scrape and sand it so that the moisture can penetrate into the grain.

When gluing up work on which it is impossible, because of the shape, to make a screw clamp hold, wrap the glued joint with heavy cord and tie it tightly. Do not stint the wrapping because each overlay increases the pressure.

A slight film of oil on a cutting edge will ease a tool through old dry wood without chewing it and will allow you to control the tool with greater accuracy. In driving screws into very hard wood, drop a little oil into the drill hole or draw the

thread of the screw through cup grease before starting it.

An oil can filled with kerosene and one with gasoline will be found useful additions to the bench. There is nothing better for hand stones, either natural or artificial, than kerosene. They cut faster with it and are more easily kept free from muck than with the heavier type of oil.

Clean your hand stones with gasoline occasionally; you will find that they will cut much easier.

Hard Arkansas finishing stones cut best when treated with water and a little soap instead of oil. If your stone is filled with oil, lay it in soft wood sawdust for a few days. After most of the surface oil has been absorbed go over the stone thoroughly with a mixture of pumice stone and water. Give it a good dressing with strokes at right angles to the direction in which you use the stone. This removes any surface glaze and will make the stone cut better. Clean the stone with gasoline to remove all traces of pumice. Rub a little soap on the surface

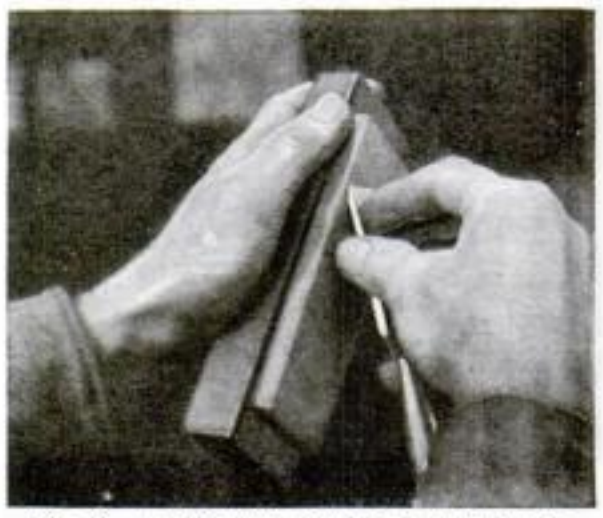


Fig. 2. Holding the chisel and stone in the hands eliminates the usual rocking tendency.

of the stone and wet it slightly when you wish to use it.

Bevel edged tools must never be ground on the back or straight side, as one secret of a perfect cutting edge is a true, flat back. When it is necessary to stroke the tool on the back to remove the burr, hold the tool flat on the stone.

In removing nicks from the edge of a tool, grind from the heel of the bevel up to within a narrow margin of the cutting edge as shown at the top of Fig. 3. Do not grind off the edge, but work that into shape on a coarse hand stone. This method eliminates the danger of burning the thin edge in grinding. If a deep nick must be ground out, the edge left by the grinding wheel must all be worked off on the hand stone before you can finish it to a keen cutting edge.

In honing chisels, plane cutters, and carving tools, hold the stone in one hand and the tool in the other (see Fig. 2). In this way the tendency to rock the tool is eliminated, and it is possible to get a much flatter and truer edge. Hold both the stone and the tool just firmly enough to insure easy motion (see Fig. 1). In delicately filing wood or metal, it is often an advantage to hold the work in your hands for similar reasons. Both work and file may be kept in any desired relation to each other with a high degree of precision.

By draw-boring mortise and tenon joints (see Fig. 3), it is possible to insure an extra tight fit. Drill the hole for the

dowel through the mortise, insert the tenon, and, with an awl or pencil point, mark the center of the hole on the tenon. Next, withdraw the tenon and drill the dowel hole, making it slightly off center and toward the shoulder. If it is a soft wood that will draw up easily, you may shift the hole quite a bit, say a scant 1/8 in. or less. If hardwood is being used, 1/32 in. may be sufficient. Carefully insert a well-pointed dowel and drive it through.

When planing down to a scratch gage mark, draw a soft pencil through the scratch. When the plane is down to the scratch the pencil mark will be visible from the top. You may make a series of small holes with an awl at intervals in the scratch mark, and when they show it will serve as a warning to proceed with care.

In ripping a thick board or a wide thin piece of lumber with a hand saw, turn the work over frequently so that the wood

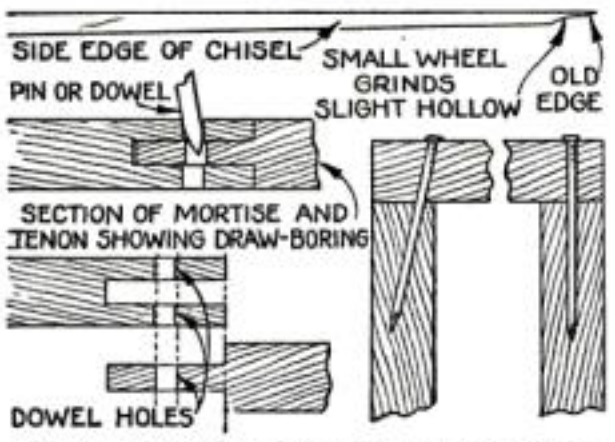


Fig. 3. Grinding a chisel, draw-boring a mortise and tenon joint, and driving nails into an edge.

is sawed from both sides. This will insure keeping to the line on both faces.

Use a coarse tooth saw for soft wood and a fine one for hard wood. In sawing thick lumber, rock the saw and change the angle of approach frequently.

When using a saw keep your eyes on a line with the blade and straight down the back edge. Do not grip the saw handle any harder than is necessary to control the blade. Take long strokes the full length of the saw, and follow through with a straight thrust to the end of the stroke.

In making round wooden rods, first saw and plane them either square or flat, as the case may be. If you wish to make a round rod, spar, or flagpole, square it carefully to the diameter of the round wanted, work the square into an eight-sided figure, and then round off the eight corners of the octagon. If you wish to round off the edge of a table top, plane a bevel on the edge and then round off the corners of the bevel.

Hollow-Square Saw Bench

ONE of the most valuable devices I have used in many years of practical carpentry and shop work is a saw bench made in the form of a hollow square—just a rectangular frame supported by four legs. It is exactly like the framework of a low table with the top removed.

Such a bench is particularly convenient for supporting material that is to be ripped or cut with a compass saw. It is equally useful for holding work which is to be nailed together or clamped for gluing.—F. G. SEMPLE.

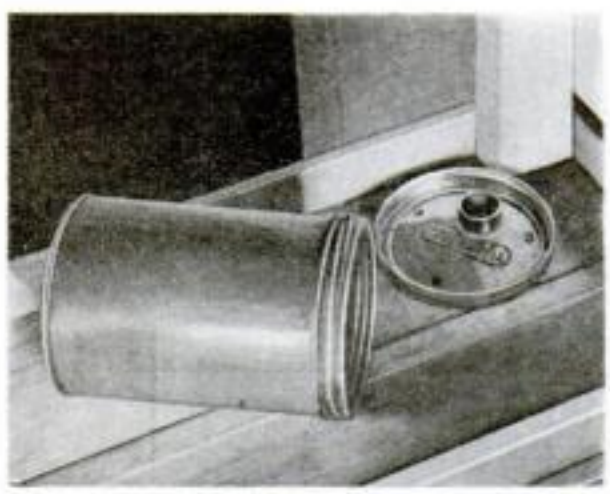
A definite program for getting ahead financially will be found on page four of this issue

Kitchen End Table Holds Extra Pots

THIS convenient kitchen end table is designed to hold the pots and pans which are not for the moment being used on the stove. A table of this sort need not be wide, but should be of about the same height and depth as the stove. The top should have a wear-resisting, heat-proof finish, such as may be obtained by staining the wood and oiling it several times with linseed oil, well rubbed in. If preferred, the top may be covered with zinc or asbestos.

The top is protected by a wear-resisting, heat-proof finish or is covered with zinc or asbestos.

A hidden receptacle for burnt matches made from a screw-top coffee can is an added feature of the table illustrated. To receive the matches, a 1-in. hole was bored near one corner of the top and a 3-in. length of brass tubing forced into it until flush with the surface. A hole of the same diameter as the tubing was cut in the coffee can top, which was then fastened with screws on the underside of the table top as shown in the lower photograph. With a twist or two the container itself may be removed when necessary to empty out the accumulated burnt matches.—WALTER E. BURTON.



View of the underside of table top showing the top and body of the burnt match receptacle.

How to Make Out a Money-Saving Lumber Order

By CHARLES A. KING

ALICE and John were cosily settled for a quiet evening when the purr of a car coming to a stop and the slamming of a door caused them to glance inquiringly at each other.

"I guess that's Fred," said Alice, "and Dorothy is with him," she added, as the sound of light and heavy footsteps mingled on the porch.

"Good evening, folks," was Dorothy's greeting as she and her husband entered. "Fred wanted to see John about his home workshop, and I wanted to see you—so here we are."

After chatting for a few minutes, John took Fred into his comfortable, well-arranged little shop, where there was always interesting work to be seen.

"What I want your help about," said Fred, "is making out a stock order; that is, a purchasing list of materials such as I need when I go to buy the lumber for making a piece of furniture or the like. For instance, I'm going to build a broom cabinet from this POPULAR SCIENCE MONTHLY Blueprint number forty-nine. Now the blueprint gives a list of all the pieces of wood and their exact sizes—everything anyone needs to know for actually making the cabinet—but I want to find out just what to order and how to order from the lumber dealer."

Being director of woodworking in the city schools, John often had helped Fred in his hobby of making small articles, and he knew that this particular project was the most ambitious piece his friend had undertaken.

"You must first recognize, Fred," he began, "the differences in the objectives of a stock order, stock bill, or lumber order, and what is often called a cutting list, fitting list, or factory list. The list on the blueprint is a cutting or fitting list; it gives the number of pieces, their exact sizes as far as possible and their names, which indicates their uses and how they are to be cut or milled. Also, there are letters to tell where each piece is to go."

"THIS seems pointed in the direction of what I am anxious to learn," said Fred. "Beginning with the fitting list, what is the next step?"

"You must become familiar with the blueprint in all its details, but you can use the cutting list to save measuring. Generally a stock order is made from a broad conception of the whole, refined only enough to order boards of dimensions from which the different pieces may be cut with minimum waste and boards which conform to the sizes commonly carried in a well-stocked lumberyard. The one who makes out the stock order must know the standard thicknesses, widths, lengths, and grades of the various materials.

"Lumber of practically every kind in common use comes from the mills in

thicknesses between one and three inches, and sometimes thicker. Usually boards thinner than one inch are resawed from planks, while packing box and other special lumber may be sawed directly to the required thickness."

"Generally the widths of boards range between six and twelve inches. Although boards up to fourteen inches wide and in some cases wider are cut from large trees, they are seldom more than fifteen inches wide and then are ordered only for special purposes. Wide boards are likely to warp and twist in seasoning, and if no thicker than one inch, they may split in handling. In lengths, boards range between eight and twenty feet, though probably three quarters of all stocked lumber is either twelve, fourteen, or sixteen feet long, and varies by multiples of two feet.

"YOU will notice that in this drawing only over-all dimensions are given, the smaller pieces being dimensioned in the fitting list and identified by letters instead of being indicated on the plan. As the blueprint is for amateur use, this is the better way."

"Yes," assented Fred, "I should think so because the many lines and figures necessary upon the print would be confusing to one not accustomed to working from plans."

"Now for the list," said John. "We find that eight stiles or sidepieces are required for the case and the door, all two and a half inches wide and so nearly the same length that we may consider them the same. How wide a board would you order for these stiles?"

"Well," replied Fred thoughtfully, "eight pieces two and a half inches wide would require a board twenty inches wide."

"That is true," agreed John, "but can you cut eight pieces of that width from twenty inches?"

After pondering the question, Fred answered, "I didn't allow for the width of the saw cuts nor for waste in working. How much should be allowed?"

"For pieces nearly six feet long, about a half inch should be allowed. Each piece must first be cut roughly to length and width, one edge straightened on the jointer, and each piece finally cut to its exact width and length with fine fitting saws, and later rabbeted, grooved, or molded as required."

"THEN the board would have to be twenty-four inches wide."

"Yes, if we ordered it that way. But do you think that after all these years of wasteful lumbering methods, boards of such width are so common that they are cut into narrow strips?"

"I don't know," answered Fred. "Aren't they?"

"They are very rare and command very high prices, and narrower boards may be purchased and worked more economically."

"I suppose we can cut a board twenty-four feet long and six inches wide in pieces six feet long, which will just give the eight stiles."

"We might, but are boards twenty-four feet long more common that boards twenty-four inches wide?"

"I suppose not, so perhaps it would be best to order one board twelve inches wide and twelve feet long."

"Exactly. Now about the shorter pieces; we will begin with the largest first. The top is twenty-four and the bottom nearly twenty-one inches long, so both pieces may be cut from a board four feet long, as it is not customary to cut fractions of feet. The top is seventeen inches wide, and the bottom fifteen and three eighths wide. How wide should the board be?"

"If it were seventeen inches wide, it would be wide enough for both pieces, but there would be some waste," answered Fred.

"Usually. If we were ordering for a large job, we would specify the desired number of square feet of random widths and the required length or vice versa according to our needs, because in general pieces over ten or twelve inches wide are glued from narrow boards."

"WHY is that?" queried Fred. "I should think that one wide board would be much better than another made of narrow pieces."

"It may seem so, but as a matter of fact the opposite is true, for one wide board is more likely to warp than a board made of several pieces, each of which warps separately. A skilled workman arranges the pieces so the warp of one is offset by the opposite warping of others; hence we will order one board ten inches wide and eight feet long."

"Wouldn't that make a board twenty inches wide and therefore waste three inches? Why not say nine inches wide, which would waste only one inch?

"If we happened to get a perfect board, that might be safe for an expert workman, but we must allow for edge blemishes and for making the joint. Also, boards are stacked out of doors for several months for weather drying and furniture and finishing stock is then kiln dried, in which process practically every trace of moisture is removed by evaporation. What will be the result?"

"I suppose the board will shrink and warp more or less."

"SURELY, but just now we are more interested in shrinking. A green board sawed twelve inches wide will shrink from one quarter to one half inch in width, depending upon whether it is plain or quarter-sawed and the kind of wood, for plain-sawed lumber shrinks more. When your ten-inch board reaches you, it will be about **nine** and five eighths inches wide. Work off bad edges, make the joint, and the board will not be a great deal too wide; in any case a nine-inch board would probably not be wide enough to allow for squaring. Now for the short pieces: there are eighteen two and a half inches wide—we will say three inches. Twelve of them will average a foot in length, so a board six inches wide and six feet long will give them. Six other rails average about twenty inches long and will require five feet in length. Thus the rails will need eleven feet in length. How shall we make the order?"

"I should say eleven feet long," Fred answered without hesitation.

"But the dealer will have to cut it from a twelve-foot board," objected John.

"Then we will order the board six inches wide and twelve feet long, for we will have to pay for it anyway."

"Just so," said John. "Let's take the shelves next. The top shelf is three quarters by eight by twenty-two and a quarter. As three-quarter-inch boards are rarely carried in stock, the thickness usually being seven eighths or thirteen sixteenths, we will change the length of the ten-inch board from eight to ten feet, which will allow for the top shelf. The piece may be planed by hand to three quarters inch thick. Next, a board five eighths by eight inches will be needed for the shelves, shelf end, and the drop door. It will have to be seven feet two inches in length. What shall we order?"

"THE board should be five eighths inch thick, nine inches wide, and eight feet long," answered Fred.

"Correct. Now you seem to catch the idea. And remember always to cut the large pieces first from the boards which will cut with the least waste. Now let's see if we have everything."

They scanned the print and added some stock for racks, cleats, and shelf rests.

"But how do we order the plywood panels?" asked Fred.

"Well, that stuff is like glass in that an order for a special size is cut from the next larger size in stock, for which the buyer must pay. We want one piece eighteen by sixty-one inches, two pieces twelve by sixty-one, and one piece twenty-two and a quarter by sixty-one. In general, three-ply wood is stocked in sizes of twenty-four, thirty, and thirty-six inches in width, and sixty, seventy-two, and eighty-four inches in length. We have one panel eighteen inches wide which must be cut from a twenty-four-inch board, an unavoidable waste. Then we want two panels twelve inches wide which may be cut from another twenty-four-inch board, while the twenty-two and a quarter inch panel will take another. Thus we need three boards twenty-four inches wide. The print calls for sixty-one inches in length, which is one inch more than the stock length of the panels."

"THAT means that the panel must be cut from the next length. How may that waste be avoided?" asked Fred.

"A slight change in the design will prevent this waste; the bottom rails of all the sides and door may be made one inch wider, which will allow the panel to be made sixty inches long. The difference in the design will not be important."

"That would make a difference in the stock bill," commented Fred.

"Yes," agreed John. "What shall we do about it?"

"The rails were to be cut from the seven eighths by six inch board twelve feet long, if I remember correctly; why not add two inches to its width?"

"That's the way to do it, so we will make that board eight inches wide instead of six. If you make this adaptation, you will use three pieces of three-ply board twenty-four inches wide and sixty inches long, or seventy-two inches long if you decide to let the present design stand."

A definite program for getting ahead financially will be found on page four of this issue.

"By the way," said Fred, "You remember the last time you took dinner with us, we talked about a dado around the dining room; why not make it of this three-ply stuff?"

"You can, for the panels come with either one or both sides finished in almost any kind of wood. They are made in various numbers of plies; and with selected facings, you can obtain beautiful grain effects."

"NOW," said Fred, "I guess the list is done, for the plywood was the last item, I believe."

"Not too fast. We have said nothing about the kind or grade of lumber. Standard gradings are changed from time to time, but for small orders it is of minor importance. We must however make some statement."

John tore a sheet from his notebook and wrote the following order:

MATERIAL FOR BROOM CLOSET

ALL material to be of clear, sap-free whitewood, one side free from bad discolorations and other hurtful blemishes.

1 board	7/8" x 12" x 14' 0"	D 2 S
1 board	7/8" x 10" x 12' 0"	D 2 S
1 board	7/8" x 8" x 12' 0"	D 2 S
1 board	5/8" x 9" x 10' 0"	D 2 S
3 three-ply boards	24 x 60" (72?)	

"From now on," said Fred, "I think I shall be able to make an intelligible stock order. Is there any conventional way of writing down the items?"

"No. If the list is clear to the dealer and the stock cutter, that is all that is necessary. Terms vary in different localities and in different shops. Sometimes the thickness of the board is placed first and sometimes the length. Usually the small dimension comes first, but this is not universal."

"What does 'D 2 S' mean?"

"Dressed two sides. If that were not specified, the dealer would be justified in sending the boards in the rough, although it is hardly likely that he would do so, since he knows what the lumber is for."

"What sort of boards would be dressed differently?"

"COVERING boards, underfloors, and box boards are often dressed only on one side, not for smoothness but to make them of uniform thickness in the interest of greater economy in working them. Corner boards, standing finish, and square-edged floor boards are dressed four sides to insure uniformity. Often in unplastered camps and summer cottages, the studding and all boards are planed on the sides which show in the rooms. This planing reduces the thickness of one-inch boards to the standard thickness of seven eighths."

John pointed out that sometimes the delivery of a small order may be simplified by a notation that certain boards may be cut across at a given distance from one or both ends.

"In this case, fourteen feet is a rather awkward length for so small an order," he said, "but this may be remedied by cutting the stiles from one end. The other boards may be cut the same way with a little planning."

"I will take this list to Sheldon in the morning. I wish, however, that I could

have the boards cut up somewhere near the sizes I want."

"Well, you can have the lumber delivered at a job shop—Davis', for example. He will work every piece to just the sizes and shape the fitting list calls for. Probably he would get out the entire order for you, because he carries a good stock. But he would have to charge you more than Sheldon would. In fact, his price would probably stagger you. We have spent some little time studying the print, and he would have to pay a high-priced workman to do the same thing, and also for his time in laying out the pieces so they may be cut with minimum waste. Machine work, requires time. It takes as much time to knock down and set a machine for a small order as for one many times larger; all this would appear in your bill, plus the overhead charges."

"THEN what am I to do?" asked Fred. "Sheldon can't cut up the stock, and Davis' price would be almost prohibitive."

"There are three methods. The first we may call the factory method, which I have just described. The second we shall call the yard method: you go to the lumberyard with the purpose of each board on the order clearly defined, keeping within the range of straight crosscuts with the power swing saw and lengthwise cuts with the power rip saw. For example, the eight inch by twelve foot board from which the rails are to be made may be cut across six feet from one end and that piece sawed down the middle with a circular rip saw for the bottom rails; the other piece may then be ripped for the other rails. Sheldon has machines for this sort of work, but not for the finer cutting. The other boards may be cut by the same method. This will not be as expensive as the factory method.

"The third method may be called the personal method, which I should follow if I were working as you are. All the stock your order calls for should be delivered at your house. Lay the pieces out carefully with allowances for working, see that your saws are sharp, and go to it. It will be fine exercise for you after a hard day at your desk. Furthermore, the waste wood which will be useful for other jobs, will be in your hands instead of in the scrap pile in the shop."

"JOHN, you are absolutely right! I have already found that a couple of hours playing at my bench in the evening has rested me far more than reading or any social affair. I will order the boards and cut them by the personal method."

Dorothy's voice from the doorway broke into their conversation.

"Talk about women talking!" she exclaimed. "It is nearly midnight and you boys have been talking a steady streak since half past seven. You come right along home, Fred."

"Well," said Fred as he sprang to his feet, "I just didn't realize—I have been so interested in what John has told me that I have thought of nothing else. It's certainly been a worth while visit. I've learned all I want to know about ordering lumber."

New Ideas Sweep Movie Studios

(Continued from page 23)

step was the installation of a large, complete sound stage, where conditions prevailing in actual production practice may be duplicated It is fully equipped with microphones, camera motors, and all other apparatus necessary for the taking and finishing of talkies.

Of the studio innovations, the most important is the Schufftan process, the invention of Eugen Schufftan, a German artist, through which German and English producers have been enabled to make "million-dollar" pictures at trifling cost. Recently, the first Schufftan unit of two experts arrived in southern California. As a result of their work there, you soon may see "super-features" with impressive sets and foreign backgrounds, such as great cathedrals, medieval castles, majestic mountain scenes, which have been produced inside a Hollywood studio at an outlay of a few dollars.

DEMONSTRATED at a meeting of the Kinematographic Group of the Royal Photographic Society in London recently, the process amazed experts by its ingenuity and simplicity. Described briefly, it is a method of combining real sets with small models, or combining photographs with small inexpensive sets in such a way as to blend the two into a whole and make detection by the spectator impossible. So perfect is the illusion that, when the finished picture is thrown on the screen, Schufftan technicians themselves cannot tell where the set leaves off and the model or photograph begins. Yet all that is required is an optical mirror and a large lens—plus a knowledge of angles and a highly developed technique of film lighting.

With such simple equipment, Schufftan has been able to show on the screen foreign scenes, including the Colosseum in Rome and the Vienna Opera House, without leaving the Ufa studios in Berlin, using photographs instead of costly sets imitating these huge historic buildings. In *Atlantis*, a German film based on the Titanic disaster, Schufftan's process was used in many of the interior scenes. The director wished to make various shots showing the passengers being engulfed with the sinking ship. By the old method it would have been necessary to flood the studio or lot and build an expensive set merely to destroy it. A model of the top of the liner's ballroom was built. The actors floundering in a small tank provided the remainder of the scene. The result is as realistic as would be a picture made at great expense and effort.

METROPOLIS, the German film which a few years ago attracted international attention chiefly because of its futuristic sets that appeared in gigantic proportions on the screen, employed tiny models and the Schufftan method. The models were built for a few hundred dollars. Actual sets on the scale suggested would have cost a considerably large fortune.

A most realistic battle scene was produced with a cheap model. The actual studio construction involved was one shell crater in which the actors played the sequence. Across the small model of the battlefield, a miniature airplane moved in flight. As the toy plane crossed a designated spot, a tiny calcium bomb exploded and brought it down. The effect was startlingly lifelike, though it cost less than $100 to produce. Another Schufftan set, supposedly made in a great astronomical observatory, employed an ordinary table microscope to give the illusion of an enormous telescope.

According to Hans Nieter, a young German-American camera man who worked in the Ufa studios with the Schufftan process since its beginning, seventy per- (Continued on page 144)

New Ideas Sweep Movie Studios

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cent of all German productions now use the method. To date, twenty-three British pictures have been made with its assistance. Soon after his invention was introduced in the German studios, Schufftan was invited to Hollywood to demonstrate it. He remained several months but no one seemed to take his work seriously and experiments were abandoned. That was five years ago. Meanwhile, however, sound has come into its own. Now, with the small studios necessary for talkie production and the great difficulty of reproducing sound in outdoor scenes, synthetic sets have become a vital problem. Thus it is expected that the Schufftan unit which arrived in the movie colony the other day will prove the nucleus from which will grow the general adoption of the system in this country.

These, then, are the three major new developments in movie making technique—color, wide film, and the Schufftan process. What are their secrets? To begin with technicolor: It is the invention of Dr. Herbert T. Kalmus, a former professor of the Massachusetts Institute of Technology, who, with a group of scientists, worked more than a decade to bring it to its present state of development. This is how an expert explained the process to me:

THE scene you will eventually see spread on the screen in glowing tints is taken with a special camera. It is equipped with a prism arrangement which, because it splits the scene into two duplicate parts, can take two identical pictures at the same time on succeeding sections of film. In consequence, twice the footage is used for a given scene. Through color filters placed in front of the upper and lower frames of the film, which is color sensitive (panchromatic), one section registers only the reddish or "warm" colors, and the other the greenish or "cold" colors.

The film, when developed, resembles a normal black and white negative, except that each alternate exposure includes only the red or the green. Two separate positive films are printed which are to serve as "blocks" in the printing of the final film. One of these two positives forms a continuous strip of only the red frames of the negative; the other of only the green.

The two positive films are chemically treated so that the dark portions of the image are caused to swell out from the surface of the film. The uneven surfaces thus created later act in the printing process like the raised letters on a rubber stamp. A dye of suitable reddish shade is applied to the positive of the red parts of the picture prepared in this way, and by mechanical contact the red portions of the scene are transferred to a blank film. The green parts of the scene are printed from the other positive film directly over the red impression. The resulting film in full color can be run through any projection machine in the ordinary manner.

AS FOR Grandeur and Spoor-Bergren films, the pictures are taken and projected with more highly corrected lenses capable of giving sharp detail to the edges of a wider field. The chief technical difficulty lies in running the seventy or sixty-five millimeter film through the camera and later through the projector and keeping it from buckling and causing areas of the picture to appear out of focus. This, technicians say, has been overcome by a special mechanism which practically "floats" the film through camera and projector on a "cushion of air." Details of the method, however, are still being kept strictly secret.

To obviate the buckling obstacle, Leon F. Douglass, a California experimenter, has devised a panoramic lens (Continued on page 145)

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which permits pictures for projection on the new wide screens to be taken upon film of standard width. Another advantage of this invention is, of course, that it would save the added expense of the double film. Working on the same principle as the distorting mirrors seen at amusement places, it condenses a double-width picture into a single width of film. An adjusting lens in the projection machine restores the picture to its normal proportions.

While two motion picture companies are said to have adopted the Douglass lens, a technical man predicted to me that its application would not prove highly successful. Due to excessive magnification of the silver grains, he explained, the enlarged picture on the screen would be marred by coarseness and lack of detail.

AND how does the Schufftan process work? Like many other discoveries it is so simple that the fact that no one ever thought of it before is a matter of amazement.

An optical mirror, with its silvering on the front instead of the back, does the trick. Let us suppose that the scene to be taken is to represent a cathedral interior showing the organist and choir. All that is built are two inexpensive sets, made of the usual canvas or plaster of Paris, depicting the immediate surroundings of the organist and the choir. In these settings, the actors "do their stuff." An ordinary movie camera is used. Before it, the mirror is placed at an angle of forty-five degrees. At one side a transparency, model, or photograph of the cathedral interior is set up in such a way that the mirror reflects its image into the lens of the camera. But the silver surface of the mirror in front of the camera lens blots out the two small sets and the actors. Before the scene is shot an expert scrapes off enough of the silvering to let actors and real sets appear through the glass.

The sets, photographed at a much greater distance than the image of the model or photograph of the cathedral interior, appears on the film in exactly the same proportion. Thus the action on the film seems to occur apparently in the proper places inside the cathedral. A large, thin lens resembling in appearance and action a huge spectacle lens is placed between the transparency, photo, or model of the cathedral and the silvered mirror. It is ground so as to correct the focus of the near-by cathedral picture and make it seem, to the camera lens, to be as far away as the actors.

This trick method of focusing sharply objects at different distances from the camera is responsible for the success of the Schufftan process.

MODELS were used in the early days of the movies, but it was difficult to photograph actors at the same time. An improvement was a method somewhat similar to the Schufftan process (P. S. M., Jan. '27, p. 15), in which the upper parts of a cathedral, for example, were painted on glass and placed in front of the camera in such a manner that they appeared to be a continuation of the lower parts, which were actually built.

What will be the next revolutionary change in the movies? Obviously, it will be practical three-dimensional pictures—that is, movies with true stereoscopic effect in which images have length, breadth, and depth as well. A few weeks ago, Dr. Donald Clive Stuart, professor of Dramatic Art in Princeton University, went so far as to declare that the present generation would see them. When I repeated his prediction to a motion picture engineer, he shrugged his shoulders and smiled. "Perhaps," he said. "Who can tell?"

A definite program for getting ahead financially will be found on page four of this issue.

Where America Gets Its Booze

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tured alcohol had made that source effectively expensive. Dr. Doran showed me figures to prove that the bootlegger then turned to the cheaper method of fermenting sugar or similar substances, distilling the product to make the needed raw alcohol. Prohibition officials believe that is what the vast majority are doing now.

ALCOHOL can be produced by the microscopic yeast plant from any ordinary kind of sugar—cane sugar, beet sugar, corn sugar, fruit sugar of any kind, waste molasses, waste fruit juices, and many other materials. Potatoes or grain will yield alcohol after their starch has been converted into sugar by an enzyme called diastase. This is the purpose of sprouting the grain or "malting" in the old-fashioned methods of making whisky. There are also chemical methods of converting the starch into sugar, and all of these materials—potatoes, grain, sugar, molasses, and many starchy or sugary wastes—are used in one factory or another for the manufacture of industrial alcohol for legitimate uses.

Recent seizures by the prohibition authorities, said Dr. Doran, indicate that the present chief source of alcohol for the bootlegger is sugar which is fermented with yeast and then distilled. According to the old-fashioned methods of making distilled liquors, this process would yield a rather inferior kind of rum. But the bootleggers use a modern chemical still and "rectifying column," exactly like those developed for the legitimate alcohol industry. As a result the product is not weak rum, but is concentrated, reasonably pure alcohol, from which the local "distributor" or "jobber" can make rye, gin, Scotch, wine, or the "finest imported liqueurs."

Statistics of present-day use of alcohol are admittedly very inaccurate. Dr. Doran's office estimates the present production of illicit alcohol at about 30,000,000 gallons a year. I should be inclined to put it a little higher.

DR. DORAN convincingly proves that of this thirty or thirty-five million gallons of annual American booze at least 25,000,000 gallons is coming from distillation in large, hidden stills. Chiefly, the material fermented and distilled is sugar, although some grain, some potatoes, some fruit juice, and perhaps a few other materials may play small rôles. Sugar is the big source of supply for the bootlegging industry; the chief basis of their $3,000,000,000 business structure.

Some industrial alcohol and denatured alcohol probably is still being reconditioned or diverted. For example, several bootlegger-manufacturers have been caught buying cheap toilet waters or lacquer thinners and solvents, removing the oils by chemical and distillation processes, and adding the alcoholic product to the bootleg stream. Perhaps two or three million gallons of alcohol came from this source into the bootlegging industry last year. The only other prominent source is illicit importation and "rumrunning." This is spectacular but from the standpoint of the bootleg barons it is almost useless. Dr. Doran does not believe that more than two million gallons a year enter America this way. I have been given larger estimates by others but I agree with Dr. Doran.

This fact may have interest for intending purchasers who hear in New York the story that "this just came off a transatlantic ship," or in Detroit the tale of how the bottles that are offered were "just run over the river last night." Of course such rum running does happen and I would not be surprised to learn that occasionally a steward slips ashore in NewYork with a bottle of real European stuff. But were rum running or Euro- (*Continued on page 147*)

Where America Gets Its Booze

(Continued from page 146)

pean steamships to bring into the United States each year all the alcohol that Americans drink, there would be little room in the steamships for cargo, and tourists would be crowded from the roads across the international boundary.

The bootlegging industry is beginning to realize the weakness of this claim of importation and to sense the value of the well-tested business policy of always telling the customer the truth. While getting together the facts for this article I found a reasonable sprinkling of bootleggers who said frankly that their wares were made in America from raw alcohol, but that both alcohol and wares were good.

The question of how much booze do Americans drink is just as important as where the liquor is coming from. Do people drink more or less than before prohibition?

INACCURATE as are all present statistics and estimates of alcohol consumption, they still permit a rough answer to this question. Americans are drinking less; about one fourth as much, in fact, as they drank fifteen years ago. But the decrease is chiefly in the kind of alcoholic drinks which generally are admitted to be least harmful; that is, wines and beers. Of hard liquor, Americans are drinking about three fourths as much, per average individual, as they did before prohibition.

These conclusions are not Dr. Doran's, although I think that he might agree with them. They are based on official statistics plus calculation which I have made of the average annual use of alcohol per individual over fifteen years old in the continental United States. Correction is made, of course, for the increase of population between preprohibition times and now. Before prohibition the average American over fifteen drank about one and four tenths gallons of hard liquor a year and about twenty-five gallons of beer or wine. Reduced to the basis of contained alcohol, the average annual alcohol ration, before prohibition, was about one and seven tenths gallons.

Now, as closely as I can estimate it, the same average individual over fifteen years old is drinking about one and two tenths gallons of slightly more diluted hard liquor each year and less than a quarter of a gallon of beer and wine. This merely confirms what is evident to general observation, that the bootlegging industry does not care to handle bulky, easily spoiled products like wine and beer when it can handle the concentrated, stable industrial product of raw alcohol.

REDUCED to alcohol, present drinking gives the average American, I estimate, an annual dose of a little over four tenths of a gallon as compared with the preprohibition record of about one and seven tenths gallons. That is the measure by which prohibition actually has cut the drinking of alcohol.

In money, of course, there has been an increase instead of a decrease. Figures which I have prepared as carefully as possible, but which still are no more than rough guesses, convince me that the booze bill of the average American adult before prohibition was about $17 a year. At present I believe this bill to be at least $35 a year, something over twice as much. That is how the bootleg barons get three billion dollars a year out of this youngest of American industrial giants.

Coming soon—a fascinating article on modern railroading, made safer and more luxurious every day by new wonders of invention and engineering. An expert tells in a forthcoming issue how the romance of the Iron Horse has led to the steel-paved highways of this age and shrunk the country's map for travelers.

Hypnotism Fake, Says Magician

(Continued from page 25)

Catalepsy, or muscular rigidity, is accomplished by the professional hypnotist in the following manner: A "horse" stands in the center of the stage. After stroking the man's forehead and temples, the hypnotist suddenly shouts "Rigid" in a voice that frightens all the women and children in the audience.

The "subject" straightens and is about to fall when the hypnotist seizes him. The man is laid across two chairs, his ankles on the back of one, his shoulders on the back of the other. Three or four people stand on top of him while he lies motionless, supporting their combined weight. The "professor" apparently has endowed his "subject" with superhuman strength.

Naturally, he has done nothing of the sort. The "subject" clutches the sides of his trousers near the knees, holds his arms rigid, and keeps his back arched. He thus becomes a human cantilever and the weight can be supported.

POSTHYPNOTIC influence and hypnotic anesthesia are among the favorite stunts of the fake hypnotist. The best-known "post-hypnotic" trick is performed in the "window-sleep" experiment. The hypnotist puts a "subject" to sleep in a store window and lets him remain there from six to ten hours. This may appear wonderful to the man in the street, but it is merely a case of lying still for a long time.

When a crowd has gathered, the hypnotist enters the window, strokes the "subject's" forehead, leaves the store, and walks across the street. In a moment, he slowly raises his hand. The "subject" does the same. Presently, the hypnotist lowers his hand. The "subject" does likewise.

Amazing! But what is the secret? When the hypnotist finishes stroking the "subject's" brow, he begins counting to himself, as the "subject" also does. They have practiced counting at the same speed. When the hypnotist is across the street, he reaches one hundred in his count. He then raises his hand and the "horse" almost immediately follows suit. As soon as the "subject's" hand is fully raised, they start a new count, and the hands are lowered at another prearranged number.

The possibility of using hypnotism as an anesthetic is one of the oldest claims made for it, and the one that has given rise probably to more false and exaggerated ideas than any other.

Through training or will power, people can harden themselves to withstand considerable punishment. Prize-fighters and football players are noteworthy examples. Considerations that are for the moment more important than pain, such as money or glory, cause suffering to be minimized or temporarily forgotten.

THIS explains the demonstrations by professional hypnotists who push needles or skewers through the "subject's" flesh. It is possible to find a person who will not mind this much even on the first attempt, and who, having undergone it a number of times, become accustomed to it—particularly when financial returns are involved.

A few years ago, an Egyptian fakir came to America and won notoriety by pushing skewers through his arms and cheeks. When he gave this demonstration at a university in Philadelphia, a professor of psychology classed it as "autohypnosis," explaining that the Egyptian was his own operator and his own subject.

But it was no such thing. The fakir possessed a temperament which minimized pain. Let a hypnotist work on a man of this type, telling him that he will not feel pain, and it is probable that he will suffer little in the skewer test or possibly in a *(Continued on page 149)*

Hypnotism Fake, Says Magician

(Continued from page 148)

minor operation. Tried on an intelligent person with a sensitive nervous system, the experiment will fail.

Through hypnotism, Professor Wells states, "there may be produced changes of physiological processes not subject to voluntary control, such as alterations in the pulse rate." That is another trick of the Egyptian fakirs. Some of these "miracle men" can cause their pulse to die away in a manner highly perplexing to physicians who have tested it.

The stunt is ridiculously simple. Usually, it is accomplished by means of a block of wood beneath the armpit. Pressure of the upper arm against the block causes an immediate drop in the pulse beat.

Another famous "hypnotic" stunt is that of lying on a bed of spikes and allowing someone to crack with a sledge hammer a huge stone resting on the performer's chest.

ASTONISHING? Not at all. Proper distribution of weight makes the bed of spikes only slightly uncomfortable. As for the smashing of the stone, its size and weight, more than 250 pounds, absorbs the blows of the ten-pound sledge hammer.

Most spectacular of these feats is the "living burial," in which the fakir, in a coffin, is covered with earth. Sometimes the "miracle man" is lowered to the bottom of a river. These ordeals last an hour or longer. Without air, it seems impossible for the man to live.

Hypnotism? Hokum! The real explanation is that a person, lying quietly, and breathing very slowly, consumes a comparatively small amount of air. The cubic capacity of the coffin is sufficient for a prolonged repose.

Even the most stalwart champions of hypnotism have invariably hesitated to claim group hypnosis as a possibility. Professor Wells describes a phonograph record reproducing "a series of sentences spoken in a monotonous and commanding tone to bring about the hypnotic condition in those who hear the record." This not only supports group hypnosis; it upholds group hypnotism without an operator. It reduces the "science" of hypnotism to a mechanical operation.

IF SPOKEN words on a phonograph record can bring about a hypnotic state, so can the music of an orchestra, the beat of a distant tom-tom, or the whistling of the March wind. These sounds do affect the mental reactions of some of those who hear them. They kindle the imagination and often excite the emotions. They do this, not because they are possessed of some mysterious hypnotic quality, but because the human mind is susceptible to suggestion.

Since it is my business to present new mysteries to the public, I have studied and investigated hypnotism for many years in the hope of finding something really remarkable. But all so-called trance conditions, catalepsy, and posthypnosis that I have ever seen demonstrated obviously were fraudulent.

In order to receive recognition as a scientific procedure, hypnotism must meet its champions' claims that, through its aid, an operator can place a subject in a trance condition in which he will obey commands or suggestions of the operator. I dispute such claims and challenge anyone to prove them with a reasonable number of subjects chosen at random before a committee of capable and impartial investigators.

Until this is done, I shall continue to believe that hypnotism is the same hokum today that it was when F. A. Mesmer, the first professional hypnotist, or "mesmerizer," startled Paris with his demonstrations of "animal magnetism" at the end of the eighteenth century.

Sugar from Sunflowers

(Continued from page 55)

But it was one thing to find it and another to get it out by a cheap process. The Bureau of Standards experimenters knew they must find a way to extract it with water instead of with alcohol, as had hitherto been done. This had long been considered impossible.

Bates himself took charge of the task. Into a laboratory filled with expensive crucibles and retorts he brought a small common ice cream freezer. First, in a vacuum, he boiled down artichoke juice until only about ten percent of moisture remained. Then he poured the thick syrup into the ice cream freezer.

Instead of freezing the hot syrup, the ice cream machine was arranged to cool it gradually to room temperature. The solution was "seeded" with a few crystals of pure levulose to help along the crystallization of the rest. A sample observed through a microscope showed that more crystals were forming. When the temperature had dropped from one hundred and thirty to about eighty degrees, the cylinder was opened. It was full of crystals of levulose. The impossible had been done.

ON THE strength of that experiment and others that followed, the Bureau built its small-scale plant which until recently has been the scene of the tests. One of the first achievements was the production of 100 pounds of pure, hard, refined levulose. Of this feat, Bates says: "Probably no development in many years has opened up such possibilities for profoundly affecting man's food supply."

In the new plant which the Bureau is erecting, an attempt will be made to carry out a "continuous flow" process of mass production such as present-day sugar factories use. It will make hard, refined fruit sugar or levulose. This new sugar can also be prepared in syrup form.

Stop That Honking!

(Continued from page 74)

asked Gus. "An auto horn is a warning signal and a warning signal ought to warn and not play pretty music. Of course, there's no sense in having a horn so loud and rough that it scares a man half to death, but we've got to remember that when the difference between hearing the horn and not hearing it may be the difference between life and death, there's no sense in taking a chance on a soft sounding horn."

"There's something in that," admitted Blainfield. "Tell me, Gus, which kind of horn is better, the motor-driven or the buzzer type?"

"SIX of one and half a dozen of the other if they're both kept in good condition," said Gus. "Of course, any horn ought to be quick on the trigger. It ought to start making a loud noise the instant you thumb the button. A fraction of a second delay may be just enough to cause a crash. The buzzer horn starts instantly, though there isn't much difference, nowadays, because motor-driven horns are built so that the armature jumps into action real fast."

"Why wouldn't it be a good idea to have two horns? Then if one broke the other would work," Blainfield suggested.

"There's only one objection to that," Gus replied. "If you had the two horns working from the same button a break in the wiring would put them both out of commission. If you had them work from two different buttons on different wiring, you'd probably forget to press the other button if the first horn didn't work. Anyhow it sure is bad medicine to drive so you have to depend on the horn to keep you out of trouble."

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Nearest to Flying Like a Bird

(*Continued from page 40*)

spirals which he was making in his descent.

Such columns of air, sufficiently strong to hold aloft a heavy, motored plane, would carry a soaring ship high into the air. Along the Pacific, near Point Loma, Bowlus has run into upcurrents so strong that his machine was carried nearly 500 feet straight up. But probably the strongest rising column of air so far reported was met in the Himalaya Mountains of Asia by William Beebe, famous explorer of the New York Zoological Society. The wind was blowing up the sheer face of a cliff. At the top, he leaned out over the chasm and was supported by the rising blast. "I leaned upon the wind," he writes in his volume, *Pheasant Jungles,* "as I might stretch out upon a rock."

WHILE such strong updrafts are uncommon, the rising air currents formed by hills and dunes facing the prevailing winds are sufficient for soaring flights. At Rossitten, Germany, where the longest motorless flights have been made and where a famous gliding school is located, a half-moon of sand dunes, ranging in height from 150 to 180 feet, extends out into the Baltic Sea. The prevailing winds blow into this half-moon, strike the steep sides of the dunes, and turning upward, form the rising currents that hold aloft the sailplanes. Here pilots cut figure eights, swooping in long curves over the sea and shore for hours at a time.

The other famous German soaring place is in the Rhoen Mountains. The highest peak, about 2,000 feet, is the Wasserkuppe, meaning "water top," a name given the mountain because of the wet, clinging clouds that frequently hang about its summit. From the sides of this mountain, the soaring planes are launched by means of heavy rubber cables which shoot them out into the rising air currents blowing up the mountain side.

A few months ago, one soaring pilot had an unusual experience above this peak. He had climbed to an altitude of nearly a thousand feet when he saw a brownish cloud ahead. As he approached, the cloud dissolved into myriad brilliant-hued butterflies fluttering about in the warm sunshine above the mountains.

ON SUMMER days, the German pilots often engage in the most thrilling of all soaring feats, "cloud flying." By "hitching" their light machines to clouds they travel for long distances over relatively level country. Under every cumulus cloud in a summer sky there is a strong rising column of air. By taking off from a hill and soaring under such a cloud, the sailplane pilot is carried aloft. Practically all of the long-distance flights that have been made in motorless machines have been accomplished by combining cloud flying with the use of updrafts from hillsides.

The most famous "cloud flyer" in Germany is Max Kegel. During the last Rhoen meeting he took off in such stormy weather that two other pilots were forced to land. Driving right up to the front of an immense cloud, he clung to it and was sucked up out of sight. Battling the violent cross currents in the dense mass of turbulent fog foam, he allowed himself to be carried by the cloud's upwash to nearly 4,000 feet. Here he headed away from the cloud and soared for nearly forty miles.

Kegel built his own machine, as did another soaring star of Germany, Gottlieb Espenlaub, a carpenter's apprentice in a village near the Wasserkuppe. Espenlaub watched the machines at the annual Rhoen competition and one winter built one of his own in a barn back of his mother's house. That year, his flights were among the outstanding events of the Rhoen meet. He was the first glider pilot to make a flight towed (*Continued on page 153*)

Nearest to Flying Like a Bird

(Continued from page 152)

behind an airplane. The danger of being towed in a motorless machine behind an airplane or an automobile is so great that it should be attempted only by a seasoned pilot. Of the few serious accidents that have occurred in flying gliders in the United States, most have resulted from inexperienced pilots attempting towed flights.

While anyone with a few minutes instruction can make a hop in a primary training glider, the handling of a soaring ship demands skill that only careful instruction will give. At the Rossitten school in Germany, nearly fifty students a month are trained in handling various motorless machines. The cost there is seventy-five dollars for tuition and sixty cents a day for food. The only soaring schools in America are located at Cape Cod, Mass., where the American Motorless Aviation Corporation maintains a camp, and on the seacoast near San Diego, Calif., where W. H. Bowlus teaches pupils to pilot his soaring planes.

THE history of motorless flying falls into two groups. First, the gliding pioneers—Montgomery, Lilienthal, Chanute, and Pilcher—made the experiments that led to the Wright brothers. They jumped off hilltops and maintained balance by swinging their legs from side to side. After the airplane had demonstrated its power in peace and war, machines without motors, but with regular controls operated by pilots in streamlined cockpits, made their appearance in Germany.

In 1920, the first soaring meet was held in the Rhoen Mountains and the record made by Orville Wright in 1911, when he hovered over the Kitty Hawk sand dunes for ten minutes, was broken. The Era of Soaring thus begun culminated in the fourteen-hour flights of Schulz and Dinort. In England, there has been a recent revival of interest in gliding and soaring and new clubs are springing up. In America, Edward S. Evans has offered a $2,000 prize for the first motorless flight of ten hours. Bowlus has already stayed aloft nine hours and no one will be surprised if the ten-hour mark is shortly passed.

WHAT practical use is soaring? As a thrilling sport, its attractiveness is easily seen. But it is more than a sport. Soaring planes provide aerial laboratories for studying meteorological phenomena and for making full sized aerodynamic tests. Recently, one American pilot took off in a blizzard and watched the swirling white flakes flow past the machine, seeking new ideas for streamlining the structure. The fund of information about the effect of clouds, hills, and peculiarly-shaped valleys upon air currents is increasing due to the work of the sailplane pilots.

Moreover, flying schools are recognizing the effectiveness of glider piloting as a preparatory course for flying motored ships. The largest air transport organization in Germany requires its flyers to hold glider licenses before they are accepted as pilots of big passenger machines.

Thus not only thrilling, but also valuable, is the soaring work of these modern birdmen whose motorless planes ride on the wings of the wind.

Next month: W. H. Bowlus, America's greatest soaring pilot, tells his own story of his thrilling adventures in motorless planes. You will not want to miss this article by the man who taught Lindbergh to glide. A list of manufacturers of gliders and equipment that are recommended by the National Glider Association will be sent to any reader upon request. Address The Editor, Popular Science Monthly, 381 Fourth Ave., New York City.

Oil Makes the World Go Round

(*Continued from page 28*)

fight against friction is a bearing which lubricates itself. It is produced by placing graphite in a vacuum to extract the air and then forcing in molten babbitt or copper under tremendous pressure, sometimes reaching a million pounds. While bearings of only moderate size can be made of this "alloy" of graphite and metal, they are expected to prove valuable in textile factories where oils ruin the fabrics.

The properties of the alloy are similar to the famous self-oiling lignum-vitae wood, used for propeller shaft bearings on steamships. On the *Leviathan*, for instance, each stern tube carries two bearings of this unique wood, one seven feet long and the other ten feet long. Many of the early American clocks had lignum-vitae bearings. Some ran for a hundred years without oiling.

THERE is no known lubricant suitable for all purposes. Each machine has its peculiar requirements. A drop of airplane oil would stop a watch. Watch oil would be useless in an airplane motor. As many as twelve different kinds of lubricants are made by one manufacturer for use in automobiles. Only recently has intensive study been made of the nature of lubricants and the effect of wear upon them.

One of these tests answered the old question: Does oil wear out? The answer is: No. What does happen, it revealed, is that the oil loses its lubricating properties through the absorption of moisture, dirt, and oxygen. It is known that when oil absorbs oxygen, a compound is formed that dissolves temporarily. But when the oil strikes a cold surface, it separates as a solid material, often clogging pipes.

While laboratory tests do not determine just how a lubricant will act under actual road conditions, they have shown that all satisfactory oils have several qualities in common. They have enough viscosity, or body, to hold the metal surfaces apart. They have enough fluidity, or ability to flow, to enter into all the spaces of the bearing. They have cohesiveness so they not only adhere to the metal surfaces but the particles cling to each other so that films may be formed and maintained. They have a capacity to carry away heat and keep the bearings cool. They have low solidification temperature and high evaporation temperature. When exposed to the air, they do not dry out or become gummy. They do not have undue acidity or a tendency to corrode metal. It is in search of these qualities that laboratory workers carry on their experiments. The oils obtained from petroleum most nearly meet all these conditions.

RECENT figures show that when a "hot box" occurs on a freight car, the railroad has to haul a ton of freight 2,254 miles, practically from coast to coast, to cover the cost of dropping off, repairing, and picking up the car. In American factories, from ten to fifty per cent of all power is lost through ineffective lubrication. Cutting down this waste in power is the aim of lubricating research.

DOWN through the fertile valley where the Mississippi flows to the Gulf, thousands of men are toiling at this moment. They are building levees and dikes to tame Ol' Man River, against the time when he next will be in flood. Will they succeed? In a coming issue of POPULAR SCIENCE MONTHLY, a high Army official, one of the leaders in the work, will explain just what Mississippi flood control means and how engineers are tackling one of the biggest engineering jobs since the building of the Panama Canal.

A definite program for getting ahead financially will be found on page four of this issue.

Circuits That Improve Tuning

(Continued from page 71)

is shown in Fig. 2. By a careful adjustment of the magnetic coupling between stages, the desired band pass effect can be obtained, and in any event such a circuit materially improves the tuning. Of course, it does not add anything to the signal strength. In fact, it detracts from it somewhat and should only be used with a radio-frequency amplifier circuit that is in itself extremely powerful if distant stations must be received.

In many ways this circuit resembles the diagram of an ordinary five-tube radio receiver where two tubes are used as radio-frequency amplifiers. Coils *C* and *E*, however, instead of being in the plate circuit of a tube, are connected in series with coils *B* and *D*.

The experimenter who wishes to test out a circuit of this type will find a three-inch coil form convenient. Coil *A* should consist of ten turns of wire wound right over coil *B*, which for a .00035 mfd. condenser should have sixty turns. Coils *C* and *E* should have four turns each, and the electromagnetic coupling can be regulated by placing the coils directly at the ends of coils *D* and *F* and then adjusting the spacing. Coils *D* and *F*, of course, should have the same number of turns as coil *B* if similar condensers are used. With .0005 mfd. condensers, coils *B*, *D*, and *F* should have fifty turns of wire.

THE dotted lines indicate shielding, and it is extremely important that the units be shielded as indicated. Of course, it is hardly to be expected that a home built pre-selector circuit of this type will equal in efficiency a carefully engineered and factory built job.

If the three condensers are ganged or operated by a single shaft it is desirable to use tiny synchronizing condensers so that they can be got into step. This will make up for slight irregularities in winding the coils. In fact, the adjustment is so critical that even the best factory built selector circuits use them.

The circuit shown in Fig. 1 uses electromagnetic coupling, and on the lower frequencies which represent the longer wave lengths near the high numbers on the dials, the band pass effect decreases and the tuning becomes extremely sharp. On the high frequencies, which represent the shorter wave lengths near the lower numbers on the dial, the band pass effect broadens out materially and the loss in signal strength also is much less than on the other end of the dial.

FIGURE 3 represents another form of band selector circuit where capacity coupling is used instead of electromagnetic coupling. It is a simple circuit, easily built at home; and although there is some loss in signal strength, it will be found useful on a receiver that has a tendency toward broad tuning. Band pass characteristics also are excellent. Coils *H* and *K* are alike and should have sixty turns of wire for .00035 mfd. tuning condensers. Coil *G* should have ten turns of wire; assuming, of course, that three-inch coil forms are used. Shielding also has to be carried out carefully and trimming condensers should be used across each of the tuning condensers in the two-gang unit. Condenser *X* should have a capacity of .02 mfd.

While, as already mentioned, pre-tuning circuits of all types cut down the signal strength, the loss is not so severe as to prevent the use of such a circuit for improving the reception results when it happens that a number of local stations are so powerful that they interfere with each other. It is possible to use either one of the selector circuits shown with one tuned stage of screen grid radio-frequency amplification, a detector tube, and two audio stages in a circuit that will outclass the usual four-tube set for local reception.

Death Masks Solve Crimes

(Continued from page 26)

A negacoll cast of this safe door was made in order to preserve the robbers' fingerprints.

that, when inked, they give accurate fingerprints. Models of birds made with negacoll show the veining of each feather. Another advantage of this substance is that its elasticity permits the making of a hand and wrist as one unit, instead of in two parts. This, too, holds good in the case of the ears and other parts of the body.

To fashion a negacoll "sculpture" of the head of a living person, the operator seats his subject before a mirror. Like a barber giving a massage, he kneads with his fingers the negacoll, which has been cooked for half an hour and then allowed to cool to a lukewarm temperature. The thick, molasseslike but nonviscous material is applied in a half-inch layer. The operator begins under the chin and works upwards. In fifteen minutes the negacoll has hardened and the mask is lifted off in one piece.

The back of the head is reproduced in a similar manner, while the ears are molded separately and later fitted into the two-piece cast. So elastic is negacoll that the ear molds are pulled off like miniature gloves. A broad-mouthed syringe is used to spread the substance on the top of the head. This is done in order not to disturb the hair, which is only slightly flattened when the hardened mold is lifted.

A COMPLETE cast of a hand is made by thrusting it into a pot of melted negacoll and letting the substance harden about the hand. By withdrawing the hand carefully, a mold is left ready to be filled. For a cast of the back of the hand, the negacoll is kneaded over the hand as it lies on a table and lifted off in one piece when hardened. When the Viennese strangler was arrested, Dr. Poller fashioned striking casts of both the backs and palms of his hands.

To produce the positive, the mold is filled either with plaster of Paris or with a new substance called "hominit," also an invention of Dr. Poller, which is made in various colors. The negacoll molds can be used again or melted to make new casts.

Negacoll has proved useful for other purposes besides the making of masks of the living and the dead. Not long ago, a burglary was committed in a Vienna store, but the thieves were surprised while trying to crack a safe and fled. The police called in Dr. Poller, who made a negacoll "sculpture" of the safe door, showing accurate fingerprint reproductions. To catch the crooks took only a few days.

Stunt Flying

(Continued from page 59)

cloud. I couldn't be sure whether I was upside down or right side up. But I wasn't worried. The worst that could happen would be to come out of the cloud in a dive, upside down or in a tail spin. And stunting had taught me to recover from any of these.

On a cross-country flight, I was once flipped completely over by a violent air current during a storm. Upside-down flying prepares a pilot for a surprise like that. I usually go into an upside-down glide by pushing the stick forward at the top of a loop. This holds the plane on its back. Another method is to make a half roll, coming out in an inverted glide. In upside down flying, the rudder operates as usual but the elevator and ailerons work opposite to the manner in which they ordinarily function. To come out of an inverted glide, I pull the stick back as quickly as possible without jerking it. This brings the ship out as though emerging from a loop. The commonest error students make in upside-down flying is pulling back the stick too slowly at the end of the glide. This allows the ship to gain excess speed rapidly and to make a wide arc before it can be leveled off.

THE most spectacular stunt of all is the Immelmann turn. It is a half roll at the top of a loop. The ship zooms up and over on its back. Then it rolls over "on its feet" and flies away in the direction opposite to that in which it entered the maneuver. Great excess speed is required and the strain on the plane is such that the stunt should be attempted only with high powered, specially braced ships.

Another method of making a sudden right-about in the air is the wingover. This is a quick climbing turn followed by a diving turn. As I zoom upward, I bank and turn the plane. At the peak of the climb the bank is at its steepest and the turn at its sharpest. On the down glide, I gradually decrease both bank and turn so that the ship straightens out and ends in level flight. I have a particular affection for the wingover. And with reason.

A little over a year ago, I was bringing a Stearman plane east from St. Louis. Over Illinois, fog closed in. It drove me lower and lower. As I approached the Indiana line, I was hedgehopping at ninety miles an hour, looking for a landing field. Near Terre Haute, a huge house loomed out of the mist dead ahead. I pulled back the stick and shot up in a high wingover. It carried me into blinding fog. But I knew the maneuver would bring the Stearman around in a 180-degree turn. It would point me back in the direction I had come, over territory with which I was familiar. When I sat down in a near-by hayfield, I found that if I had zoomed up into the fog over the house and then come down straight ahead, I should have crashed into a group of high barns and silos half hidden in the mist.

THE split-S turn differs from the wingover in that the ship is stalled at the peak of its climb. I perform a fast split-S by pulling back the stick sharply and simultaneously applying full rudder. The ship climbs, stalls abruptly, falls off, and emerges from the dive headed in the opposite direction from which it started. In coming out of a split-S or a loop or a falling leaf maneuver, the ship is headed downward at a steep angle. But it is traveling below flying speed. It must dive for a second or two with elevators neutral. A common mistake by students is pulling the stick back immediately upon coming out of these maneuvers. A tail spin usually results. To get out of a spin, a pilot throttles the motor, pushes ahead the stick, and applies rudder opposite the direction of the spin.

One of the greatest stunt flyers I remember was the Frenchman, Georges Lagagneux. In 1912, he invented his hair-raising "tail-slide," with which he (Continued on page 158)

Stunt Flying

(Continued from page 157)

tempted fate—once too often. He would take up his old Farman, point its nose at the sky, stall it, and then slide backward. When the nose dropped, he would dive, climb, stall again, and repeat the reckless stunt.

A somewhat similar modern stunt is the falling leaf glide. In it, the plane descends in a series of sidewise swings through the sky. To make a falling leaf, I throttle down my motor until the plane loses most of its flying speed. When I feel the controls begin to get "sloppy," moving easily, I pull the stick all the way back, simultaneously applying full right rudder. The ship stalls and starts to fall off to the right. Immediately I reverse the rudder to full left. The plane continues to swing to the right. The wings gradually begin to tilt to the left. I hold the stick all the way back. At the peak of the right swing, the plane falls off to the left. Immediately I reverse the rudder to full right. In this manner, I swing back and forth, the plane continually in a stalled condition. To resume normal flight, I push the stick forward and neutralize the rudder.

I REMEMBER one time when I didn't need to push the stick ahead to come out of a falling leaf glide. I was about 1,500 feet up, drifting toward Roosevelt Field. It was a boiling August day. Just as I reached the peak of one swing, a powerful downcurrent of air caught the nose of the ship. The resulting dive straightened us out in a flash.

Among the most difficult stunts for a student to master is the spectacular barrel roll. In it, the plane traces a course through the air like a screw thread. To perform it, apply all controls fully at the same time. In a right roll, for instance, I pull the stick sharply back into the right-hand corner of the cockpit. At the same time, I kick over the rudder to the right fully. The nose of the plane rises. Then the ship sheers off to the right. It hangs in this position for an instant. Then it whips into rotation. Throughout the roll, I hold both stick and rudder on fully. When the ship has nearly completed a 330-degree rotation, I neutralize the elevators and apply opposite aileron and rudder to stop the rotation. This brings the ship out of the roll in straight flight. In practice, a student should always line up the maneuver with a straight highway or railroad to be sure he comes out of the roll headed exactly as he went in.

THE greatest of America's early stunt pilots was Lincoln Beachey. This reckless daredevil of the skies used to loop at 300 feet, and his vertical plunge was known as the "Dip of Death." He knew practically nothing of aerodynamics. He abused his planes in a thousand ways, and in the end "flew out of his wings" over San Francisco Bay and plunged to death.

At the opposite extreme is Jimmy Doolittle, ace of modern aerobatic flyers. He studies stresses and strains, knows just what his plane will stand before he tries a stunt. His feats are works of art. His piloting is as skillful as a surgeon's handling of his instruments. Modern transport and air mail companies are looking for pilots like that. It is skill, not fearlessness, that such companies want.

Once Beachey suggested to the contest committee of an air meet a competition in which flyers should climb to 4,000 feet, then dive vertically and see which could come closest to the ground before leveling off. And he meant it. Such a dive places a greater strain upon a plane than any other stunt. When a ship is leveled off out of a long plunge, the effect is the same as suddenly increasing the pull of gravity threefold or more. I weigh 160 pounds. At the end of a long power dive in a Curtiss Falcon, I am jammed down in my seat as though I weighed 480 pounds. And the wings are, in *(Continued on page 159)*

Stunt Flying

(Continued from page 158)

effect, supporting a ship weighing three tons instead of one.

During the war, I used to return from patrol duty high over the home field and then cut the motor, shove ahead the stick, and bring my Fokker down in a screaming 8,000-foot plunge. One of my longest spins lasted for 5,000 feet. Three fast Sopwith "Camels" were on my tail and spinning down was the only means of escape. I started the spin at 10,000 feet and pulled out at 5,000.

In coming out of a long dive, delicate handling of the controls is necessary, as jerky movements will pull off the wings. No pilot's judgment is good enough to dive at three miles a minute close to the ground. Leveling out of a long dive should be done high in the air. Stunting is like rifle shooting. Practice makes perfect. But no one ever shoots a thousand times or stunts a thousand times without missing once. And when the stunting is done close to the ground, that miss is good-by, nine times out of ten.

WHILE most stunting demands hair-trigger piloting, occasionally a flyer has to throw his ship around like a tennis racket. I remember such an occasion a little over a year ago.

I was flying a couple of news photographers to meet the *Graf Zeppelin*. We had a fast Whirlwind Fairchild. The Zeppelin didn't arrive when it was expected, so we sat down in a small field near Sea Girt, New Jersey, to wait. It was nearly dusk when we got word that the big airship had been sighted. I had to take off over the ocean. We were climbing a hundred feet above the water when the engine spluttered and nearly stopped dead. I remember thinking I would have to get that ship back within fifty yards of shore, as one of the photographers couldn't swim. But the engine caught hold again. We climbed to 2,000 feet and circled back over land. It was getting darker every minute. The motor sounded rough. Suddenly it trembled and pounded. Smoke shot from a cylinder. A piston had burned out.

From 2,000 feet, I could hardly see the ground. I spiraled down, trying to use my map at the same time, but I couldn't pick out the air field. The best open space in sight was a small field about 300 feet square, surrounded by high trees.

The only way I could get in was through a violent series of side slips. I slapped down one wing and plunged sidewise at a steep angle toward the trees at one end of the field. Then I rocked the plane over and, with the other wing low, slid toward the ground. The camera men screamed. With their arms thrown over their faces, they braced themselves for a bad crash. The plane was hardly ten feet from the ground when I kicked the rudder over, killed the side slip with the ailerons, and sat down heading into the wind. The big ship stopped with a run of a hundred feet.

That was one of the hardest landings I ever made because that tiny field, besides being inclosed by trees, sloped uphill. I had to make a right-angle turn and sit down for an uphill landing, all in a split second.

It is such landings that test a pilot's mastery over his plane—the kind of mastery he obtains from stunting. At a safe altitude, stunting is not reckless flying. It is a pilot's post-graduate course.

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THE advantages and disadvantages of different heating systems, information on fuel costs, new heating methods, automatic control, humidifying equipment, etc., is contained in "House Heating and Ventilating," price twenty-five cents from Popular Science Institute, 381 Fourth Ave., New York.

The *proof* that Ethyl develops more power

Right: This is the instrument board of a "knock" demonstration machine. The wattmeter (at the left) registers power. The tachometer (at the right) records engine revolutions per minute. When this picture was made, the engine was running on ordinary fuel.

Below: When the lower picture was taken, Ethyl had been fed into the carbureter. The wattmeter shows that the power has risen to the maximum; the tachometer shows a corresponding increase in revolutions per minute.

Knocks out that "knock"

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* * * *

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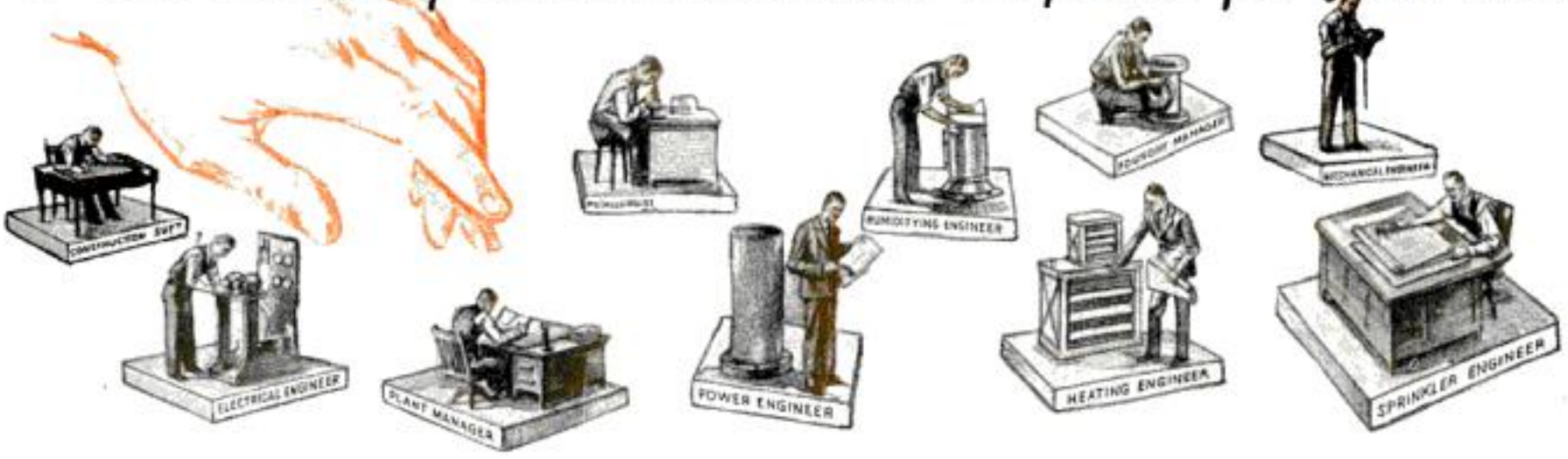

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